ENVIRONMENTAL SAMPLING AND ANALYSIS PLAN FOR NAVAL STATION, TREASURE ISLAND, HUNTERS POINT ANNEX, SAN FRANCISCO, CALIFORNIA

July 31, 1991

Prepared for:

Hunters Point Annex
San Francisco, California

Prepared by:

AQUA TERRA TECHNOLOGIES, INC.
2950 Buskirk Avenue, Suite 120
Walnut Creek, CA 94596
(415) 934-4884

By: Ronald M. Block
Ronald M. Block, Ph.D.
Program Manager

By: Leslie Rueth
Leslie S. Rueth
Project Manager

DRAFT ADDENDUM TO THE ENVIRONMENTAL SAMPLING AND ANALYSIS PLAN

DATED 27 OCTOBER 1991

IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00217.002417**

ADDENDUM TO THE ENVIRONMENTAL SAMPLING AND ANALYSIS PLAN

DATED 29 JANUARY 1992

IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00217.002522**

ATT

Table of Contents

Table of Contents
(continued)

LIST OF TABLES

LIST OF PLATES

LIST OF APPENDICES

1.0 INTRODUCTION

1.1 OBJECTIVE

The objective of the Environmental Sampling and Analysis Plan (ESAP) is to provide data to address specific environmental concerns at the Naval Station, Treasure Island, Hunters Point Annex (HPA), San Francisco, California. Environmental concerns focus on the potential environmental effects associated with the release of contaminants from HPA. The environmental effects to be addressed include potential contaminants in sediments, toxicity to organisms in contact with sediments, toxicity of storm water runoff, and potential accumulation of contaminants in surface waters. Regulatory agency comments on the ESAP and the responses to the comments are included in Appendix A.

The ESAP addresses environmental concerns resulting from activities at HPA and supplements previous environmental sampling programs. Based on the results of this study, the need for additional investigations will be evaluated.

1.2 SCOPE OF PLAN

The U.S. Environmental Protection Agency (EPA) has provided a basic framework for preparing an environmental evaluation. To the extent applicable and feasible, the following principal guidance documents were considered in preparation of the ESAP:

- EPA, Risk Assessment Guidance for Superfund: Environmental Evaluation Manual, Interim Final, Office of Emergency and Remedial Response, Washington, D.C., EPA/540/1-89/001A, March, 1989a
- EPA, Ecological Assessments of Hazardous Waste Sites: A Field and Laboratory Reference Document, Washington, D.C., EPA/600/3-89/013, March, 1989b
- EPA/COE, Evaluation of Dredged Materials Proposed for Ocean Disposal - Testing Manual, Washington, D.C., EPA/503/8-91/001, February, 1991.

The ESAP was prepared by Aqua Terra Technologies, Inc. (ATT) to supplement existing sampling plans which address potential contamination at HPA. The existing sampling plans have been prepared for the following groups of sites: Group I (HLA, 1988a), Group II (HLA, 1988b), Group III (HLA, 1988c), Group IV (HLA, 1988d), and Group V (HLA, 1990a). A description of the five groupings is presented in Section 1.4. The listed sites within each group are presented in Table 1. The location and contents of underground storage tanks (USTs) at HPA are summarized in Table 2.

Implementation of the ESAP will provide data to address the environmental effects of potential contamination at HPA by completion of the three specific task objectives: evaluation of the toxicity of sediments to appropriate test organisms; evaluation of whether persistent and bioaccumulative substances may be entering the San Francisco Bay using transplanted mussels as a biological indicator; and evaluation of the toxicity of storm water runoff to sensitive test organisms. Toxicity testing resulting in significant toxic effects will be confirmed with chemical analysis of the toxic matrix or matrices. The proposed sampling and analytical program is presented in Table 3.

The ESAP focuses on specific environmental effects involving potential toxicity and bioaccumulation resulting from activities at HPA. More comprehensive ecological effects, such as changes in species diversity or abundance, will not be addressed at this time due to the lack of

comparative background information and the numerous natural factors known to cause changes in the benthos that may mask changes associated with contaminants (NOAA, 1988). The ESAP does not address the issue of remediation. However, if chemical analyses and toxicity testing results indicate that substances from HPA are affecting sediment and water column quality offshore of HPA, further investigations may be necessary.

Following implementation of the ESAP, data generated from the evaluation of persistent and bioaccumulative substances using transplanted mussels may be used to assess potential risk to human health from ingestion of shellfish. The data used will be appropriate for specific sites within each grouping and presented in the Public Health and Environmental Evaluation (PHEE) report which will be prepared separately for each group of sites.

1.3 SITE BACKGROUND

The following site background information is summarized from the Workplan Volume 2A, Sampling Plan for Group I Sites (HLA, 1988a), unless otherwise specified.

1.3.1 Site Description

HPA is located in southeastern San Francisco at the tip of a peninsula extending eastward into San Francisco Bay (Plate 1). The HPA property covers 965 acres and is bounded on the north, east, and south by the San Francisco Bay and the Hunters Point district of San Francisco on the west. The adjoining Hunters Point district is comprised of both public and private housing and commercial and industrial buildings.

The northern and eastern shores of HPA are used for ship repair with drydock and berthing facilities. The southern shore, comprised of emplaced fill, is not used for shipping activities.

Level lowland areas, which were constructed by placing fill along the margin of the San Francisco Bay, comprise 70 to 80 percent of HPA. The remaining area is a moderately to steeply sloping ridge in the northwest portion of the HPA site. Elevations across the site range from approximately six to ten feet above Mean Sea Level (MSL) in the lowland areas to 176 feet above MSL in the ridge area.

Surface drainage is primarily made up of unconcentrated sheet-flow runoff collected by onsite storm sewer systems and discharged to San Francisco Bay. Extensive grading and construction at HPA has filled or modified pre-existing drainage channels and no naturally occurring channelized drainage crosses the facility. The encroachment of bay water to the storm sewer system has been reported at both low and high tides (HLA, 1991).

1.3.2 Site History

HPA was operated as a commercial dry dock facility from 1869 to December 1939, when the property was purchased by the Navy. Following the acquisition, the facility was leased to Bethlehem Steel Company until December 1941 at, which time the Navy occupied the facility and operated the shipyards until 1974.

The naval facilities included industrial, office, and residential buildings. Waterfront facilities included forty deep-water berths 500 feet in length and six dry docks of different sizes. The principal facility activities during the Navy's use of the site (1941 to 1974) were ship construction, maintenance, and repair; radiological experiments; and ordnance operations.

Most of the shipyard was leased to Triple A in May 1976 and used by Triple A as a commercial ship repair facility until June 1987. Triple A subleased portions of the facility to private warehousing, commercial, and industrial firms. Wastes generated were associated with ship repair and maintenance, facility maintenance, and building demolition. Waste disposal was largely undocumented by Triple A during this period of time (DA, 1987).

Activities performed by both the Navy and Triple A resulted in the use of hazardous materials including paints, solvents, fuels and oils, acids and bases, metals, polychlorinated biphenyls (PCBs), and asbestos. Information on waste generation and disposal by the Navy from 1941 through 1974, including the identification of USTs, is presented in the Initial Assessment Study (IAS) (WESTEC, 1984).

Information on the alleged waste generation and waste disposal activities of Triple A from 1976 to 1987 is limited to that developed by the Navy and the San Francisco District Attorney (DA) (DA, 1987). No data are available regarding activities prior to 1941 or activities by Triple A's sublease holders; however, the Navy has conducted a "fence to fence" survey that focused on documentation and subsequent removal of surface hazardous materials left by sublease holders, the Navy and Triple A (ERM West, 1988).

1.3.3 Site Geology

Subsurface investigations at HPA have identified four geologic units which underlie the site. The oldest identified unit is bedrock of the Franciscan Complex which is exposed in the central upland ridge area of HPA. The bedrock unit is overlain in some areas by undifferentiated sedimentary deposits which consist of consolidated sands and clays. These deposits are in turn overlain by estuarine deposits of clay, silt, sand, and peat, termed "bay mud deposits" (bay mud). Fill derived from bedrock or industrial and domestic wastes has been emplaced over the bedrock and/or the bay mud in many areas of HPA. These units are described in more detail below.

The Franciscan Complex bedrock is a tectonic assemblage of variably sized blocks of sandstone, greenstone, shale, chert, and serpentinite, often bounded by ancient inactive faults or shear zones. Serpentinite is the dominant bedrock type at HPA. Stiff clays and dense sands overlie bedrock along the southwestern margin of HPA. These units are not exposed at groundsurface, but are tentatively correlated with the "undifferentiated sedimentary deposits" reported by Bonilla (1971) and may be equivalent to the Colma formation of Quaternary age (past two million years). Prior test borings indicate that this unit is present at depth in the central and northeastern portion of HPA. However, the overall distribution of this unit beneath HPA has not been fully characterized.

Bay mud is comprised of estuarine deposits accumulated during approximately the last 11,000 years, and reaches thicknesses of about 50 feet in some portions of HPA (Lowney/Kaldveer, 1972). The bay muds consist of soft, saturated plastic silts and clays interbedded with sand and peat. Within the San Francisco Bay, these soft "younger bay mud" deposits grade into underlying stiff silts and clays termed "older bay mud" which may be present in the offshore areas of HPA. Due to the lack of soil boring data, the older bay mud cannot be differentiated from the underlying undifferentiated sedimentary deposits. Consequently, all of the stiff soils logged beneath the younger bay mud at HPA are collectively grouped with the undifferentiated sedimentary deposits.

During development of HPA, fill was placed over both bedrock and bay mud. Fill is estimated to cover approximately 70 to 80 percent of the shipyard area. There are two general types of fill; the first type is derived predominantly from excavation of the bedrock ridge and was used to create level areas for shipyard activities; the second type of fill is generated from industrial activities (primarily sandblast waste) and includes industrial and domestic wastes. The bedrock fill varies

in composition from mostly serpentinite to associated ultramafic rocks to mixtures of serpentinite and Franciscan sandstone, chert, greenstone, and shale. The Navy placed these fills in the bay margin beginning in the early to mid-1940s.

1.3.4 Site Hydrogeology

Information concerning the local hydrogeology at HPA is limited to data obtained from shallow borings and monitoring wells installed as part of previous investigations, and pilot boring completed as part of the reconnaissance activities conducted by Harding Lawson Associates (HLA) (HLA, 1990b). As a result, the shallow aquifer occurring in the fill materials at HPA is the best understood. Shallow ground water in the fill materials is unconfined and the depth to the water table ranges from 2 to 12 feet. The undifferentiated sedimentary deposits comprise the second major aquifer beneath the site; the bay mud may act as a 5 to 50 foot thick aquitard between the unconsolidated fill and undifferentiated sedimentary deposits beneath most of the site (HLA, 1990c). Ground water may also occur in isolated sand zones within the bay mud and in the fractured bedrock. Hydrogeologic conditions in the undifferentiated sedimentary deposits and the effectiveness of the bay mud as an aquitard have not been characterized at HPA (HLA, 1990c).

Ground water in the shallow aquifer probably flows radially outward from inland bedrock areas of higher elevation toward the bay, where discharge occurs (HLA, 1990c). However, local ground water flow directions may be quite complex because of variations in topography and the hydraulic properties of subsurface fill materials. In addition, tidal fluctuations and localized recharge from storms likely influence flow directions (HLA, 1990c). Additional hydrogeologic information is being obtained from the primary phase RI activities which are ongoing at HPA.

1.4 SUMMARY OF PREVIOUS INVESTIGATIONS

1.4.1 Site Characterization

There have been numerous studies performed to (1) identify sites where usage, storage, or disposal of hazardous materials may have impacted the environment; and (2) characterize existing conditions at the identified sites. These investigations have been performed under the Navy Installation Restoration (IR) program. Concurrent with the IR studies, the DA's office investigated 20 sites potentially contaminated by Triple A activities at HPA (DA, 1987); these site locations are referred to as Triple A sites.

Under the IR program, there were originally 11 IR sites (IR-1 through IR-11) planned for Remedial Investigations and Feasibility Studies (RI/FS). These are sites where there is known contamination. The sites were grouped by the Navy as indicated in Table 1 to facilitate reporting. Work plan documents for the RI/FSs at these sites were prepared. The grouping is based on the following: preliminary evaluation of the potential threat to public health and/or the environment; similarities in investigation or remediation; location of sites with respect to each other; and/or similar chemical conditions (HLA, 1988a).

Ten of the Triple A sites are encompassed by five of the IR sites; the remaining Triple A sites are separate. The remaining 10 Triple A sites were originally grouped into sites PA-12 through PA-18 on the basis of a preliminary assessment conducted for the Triple A sites (HLA, 1989). Site locations are shown on Plate 2.

As a result of the preliminary assessment and recommendations from EPA (HLA, 1989), five of the PA sites are being incorporated into the IR program in a newly formulated Operable Unit V. The prefix for the site numbers has been changed from "PA" to "IR" to reflect this inclusion.

Volume 2F to the RI/FS work plan for HPA has been prepared to address the RIs at these sites (HLA,1990a) and the field work is underway. Site inspections have been conducted at Sites PA-16 and PA-18 (HLA, 1990c). Recommendations for inclusion of these sites in the IR program will be based on the results of the site inspections. Each of these sites is included in Table 1.

In addition to the RI/FS and site inspection activities being conducted at the IR and PA sites, the Navy has conducted a preliminary assessment of the remaining HPA facility to identify areas where contamination may exist (HLA, 1990d). The areas being investigated include the storm sewer system and other underground utilities; railroad tracks; electrical transformer locations; and areas outside of existing IR and PA site boundaries.

USTs at HPA have been previously identified and investigated. Information regarding the location and status of the USTs is presented in the UST "Removal Action Plan/Closure Plan" (PRC, 1990). The number, contents, and status of each UST are summarized in Table 2. UST locations are shown on Plate 2.

1.4.2. Environmental Sampling

The above activities are being conducted to characterize sites where contamination may exist. The environmental sampling activities are planned to address the environmental impacts of contamination originating from sites throughout the HPA facility. Several previous investigations provide a preliminary evaluation of the environmental impacts.

An Environmental Impact Statement (EIS) was prepared by Environmental Science Associates (ESA, 1987) to assess the potential effects of homeporting two ships of a Battleship Battlegroup, the U.S.S. Missouri and an escort cruiser, and a nine-ship Cruiser Destroyer Group in San Francisco Bay. The EIS examined sites at Naval Air Station-Alameda, Naval Station-Treasure Island and HPA. The selection of HPA as the preferred alternative homeporting site resulted in extensive environmental analyses at North Pier, South Pier and Dry Dock #4 (ESA, 1987). The primary focus of this study addressed the potential environmental effects of the removal and disposal of dredge sediments from areas of proposed use. The environmental analyses included verification testing of dredge sediments to verify and expand upon existing chemical toxicity information from an Initial Assessment Study performed by Ecology and Environment, Inc. in 1983. The Homeporting EIS verification testing included a total of ten sampling sites, three of which were located at HPA. Each sampling station was subdivided into five replicate substations. A core sample was taken at each of the five substations within a given station and the samples composited. Each composite sample was subjected to chemical analysis for metals, cyanide, pesticides and PCBs, polynuclear aromatic hydrocarbons (PAHs), phenolic compounds, total phthalates and total volatile organic compounds (VOCs). Two station samples were subjected to suspended particulate and solid phase bioassays.

Study results indicated that the metal concentrations measured during verification testing were substantially below Total Threshold Limit Concentrations (TTLC). The organic compounds which were detected, primarily PAHs, were at low concentrations well below levels reported to have the potential for significant effects on marine organisms. Among the organic chemicals tested for, but not detected in any sediments were phenolic compounds, DDT, and phthalates. The only pesticides detected were 4,4-DDD and 4,4-DDE at low concentrations. Acetone was the only volatile organic chemical found and was present in only trace amounts.

The suspended particulate phase bioassays conducted during the verification testing indicated that the Limiting Permissible Concentration (LPC) would not be exceeded during disposal of sediments from HPA. With the exception of the amphipod bioassay test, none of the solid phase bioassays

conducted on Homeporting alternative site (including HPA) sediments exhibited significant mortalities. The mean amphipod survival in bioassay tests performed on HPA sediments was 45 percent, significantly lower compared to survival in the offshore reference sediments.

EMCON (1987) performed chemical and bioassay studies on dredge sediments in support of a maintenance dredging permit application for Dry Dock #4 at HPA. Three replicate surficial sediment samples were collected from each of five sampling sites in the vicinity of Dry Dock #4. Replicate samples were composited and were analyzed for sulfides, cyanides, metals, VOCs, total petroleum hydrocarbons (TPHs), semi-volatile organic compounds (SOCs), pesticides and PCBs, and radioactivity. Suspended particulate and solid phase bioassays were also performed on sediment samples collected from the Dry Dock #4 area. All of the analytes tested for were below regulatory target levels. The fish and mysid elutriate and solid phase bioassays performed did not indicate that the LPC of the suspended particulate phase and the solid phase would be exceeded during ocean disposal of dredge materials from Dry Dock #4, HPA.

Storm water sampling was conducted by HLA in December of 1990 to characterize selected storm water runoff sources at HPA (HLA, 1991). This study provided chemical characterization of storm water runoff quality at four locations selected to be representative of storm water runoff from various potential sources of contaminants near IR sites. Storm water samples were collected from each of the four stations and the samples subsequently analyzed for VOCs, SOCs, pesticides and PCBs, metals, TPH, oil and grease and pH.

In this study, low levels of VOCs were detected in storm water from stations SW2 (benzene at 1 μg/l) and SW4 (trichloroethene at 1 to 5 μg/l). None of the runoff or storm drain samples contained SOCs except for two runoff samples from Station SW2 which contained low levels of phenol. Aroclor 1260 was identified in one runoff sample from Station SW1, five storm drain samples from Station SW1 and three storm drain samples from Station SW2. TPH as diesel was found in all runoff and storm drain samples. TPH as gasoline was detected in two storm drain samples; one from Station SW1 and one from SW3. Three storm drain samples from Station SW1 contained oil and grease. No other storm drain or runoff samples contained detectable oil and grease. Mercury, lead, aluminum, barium, calcium, chromium, copper, manganese, magnesium, nickel, potassium, sodium, vanadium, and zinc were detected in samples from all 4 stations. Storm drain sample salinities from most storm drain stations appeared to decrease throughout the sampling period, with the exception of Station SW2 samples which appeared to become more saline during the end of the sampling period.

1.5 SUMMARY OF CHEMICAL CONDITIONS

Information on chemical conditions at HPA is essentially taken from the Workplan Volumes 2A through 2F for Group I, II, III, IV, and V Sites (HLA, 1988a-d, 1990a) unless otherwise specified. The summary provided is based on information from previous investigations. Additional site specific chemical information will be obtained from the ongoing tank closures, RIs and SIs at HPA.

Results of previous investigations at HPA indicate that inorganic and organic chemicals are present in soils at each IR site. Alleged Triple A disposal areas also require investigation and may involve widespread near-surface contamination with petroleum hydrocarbons, PCBs, and solvents. Chemicals detected in soil and groundwater from IR sites include volatile organic compounds (VOCs), semi-volatile organic compounds (SOCs), PCBs, oil and grease (O&G), heavy metals, and asbestos. Groundwater contamination has not been documented at each site. Sources of low-level radioactive materials (radium-coated dials) may be present at the landfill; low levels of radioactivity have been reported (HLA, 1990a). These levels are above background but below reportable levels. The results were presented to the public in Information Release Number 11 dated April 14, 1989

and in a Public Meeting on May 5, 1989. A summary of chemical conditions for IR and PA sites by group at HPA is described below and summarized in Table 1.

The highest sample concentrations and chemical diversity were found in Group I sites at the Oil Reclamation Ponds (IR-3), Industrial Landfill (IR-1) and Bay Fill Area (IR-2). Contamination at these IR sites consists of VOCs, SOCs, PCBs, oil and grease, and heavy metals.

Group II sites include IR-6, IR-8, IR-9 and IR-10. At IR-6, the Tank Farm, contamination consists primarily of diesel fuel and oil. PCBs are the primary contaminants detected at IR-8, Building 503 PCB spill area. At IR-9, the Pickling and Plate Yard, zinc chromate and acids are the primary contaminants of concern. Contamination at IR-10, The Battery and Electroplating Shop, consists primarily of waste acids, solvents, caustic soda and chromates

Group III sites include IR-4, the Scrap Yard and Triple A site 3 and IR-5, the Transformer Storage Yard. Heavy metals and PCBs, as well as oil and grease have been detected in soil and ground water samples from IR-4. PCBs were found in soil samples from six soil borings at IR-5.

Group IV sites include the Sub-base Area, IR-7, which consists of the painting area, the sandblast fill area and the 'additional' area. In the painting area, diesel fuel and other petroleum hydrocarbons, heavy metals and minor concentrations of VOCs were detected in soil samples. Petroleum related PAHs, diesel fuel, metals and one VOC were found in soil samples from the sandblasting fill area. In the 'additional' area of IR-7, PAHs, diesel and oil, metals and Freon 113 were found in soil samples.

Group V sites consist of IR-11, IR-12, IR-13, IR-14, IR-15 and IR-17. One VOC, SOCs, and metals were detected in samples from IR-12, the Disposal Trenches and Salvage Yard. Contaminants found in soil samples from IR-13, the old Commissary, consist of SOCs, metals, hydrocarbons and the PCB isomer, Aroclor 1260. At IR-14, the Oily Liquid Waste Disposal Area, detected contaminants include VOCs, metals and carbon disulfide. Contaminants detected at the Oily Waste Pond and Incineration Tank, IR-15, include PCBs, VOCs, SOCs, oil and grease, and metals. Aroclor 1254 was found in soil samples from IR-17, the Drum Storage and Disposal Area.

The location and status of the USTs identified at HPA has been presented by PRC (1990). The USTs are known to contain the following substances: gasoline, diesel, fuel and waste oils, solvents, and water. The number, contents, and status of each UST are summarized in Table 2. UST locations are shown on Plate 2.

2.0 TASK 1 - EVALUATION OF SEDIMENT TOXICITY

2.1 STATEMENT OF PURPOSE

The ESAP establishes the procedures to be used for the evaluation of the potential toxicity of chemicals in the surficial bay sediments surrounding HPA. Surficial bay sediments are usually fine-grained with a high surface-to-volume ratio, often resulting in high levels of chemical adsorption (NOAA, 1988). Sediment contamination originating from past activities at HPA is of concern to the Navy and regulatory agencies because of the environmental sensitivity of San Francisco Bay and the organisms which reside there, particularly deposit feeders which tend to accumulate sediment contaminants.

Contamination of surficial sediments in the vicinity of HPA is of primary concern because contaminants in surficial sediments have the greatest potential for toxicity to benthic species. Chemistry and toxicity of both surficial and deeper sediments have been investigated in previous dredge sediment investigations (EMCON, 1987; ESA, 1987) in areas of present or proposed use at HPA. Because the toxicity of sediment-associated contaminants varies widely and is often obscured by chemical extraction for analyses (NOAA, 1988), the use of toxicity testing instead of, or in addition to, chemical analyses has merit. Therefore, the method proposed for the evaluation of the surficial sediments at HPA includes toxicity testing on composited sediment samples collected at 17 stations. Chemical analyses will be conducted on composited surficial samples from each station. The proposed sampling and analytical program is presented in Table 3.

Also of concern is the potential contamination of deeper sediments in the vicinity of HPA because of the potential for exposure of these sediments through current scouring thus increasing the potential for bioavailability of contaminants in deeper sediments. However, because the bioavailability of contaminants associated with deeper sediments is considered to be limited in their current position, the evaluation of these sediments will be restricted to chemical analysis of a discrete sediment core sample taken from a depth of 3 feet below the sediment water interface at each sediment station.

The ESAP provides a methodology for evaluation of the toxicity of surficial sediments in the vicinity of HPA using a modified solid-phase bioassay procedure on selected estuarine species that may reside in the sediments. The bioassay will determine if there is a statistically significant decrease in mean survival of selected species in the sediments surrounding HPA relative to reference and control bioassays. Liquid suspended particulate phase bioassays will be conducted on sediment from the control station, three reference stations and 17 test stations to assess the toxicity of potential contaminants in the dissolved and suspended components of the sediments from HPA.

Collection, preparation, and solid-phase and liquid suspended particulate-phase bioassay procedures are referenced in the Environmental Protection Agency/Corps of Engineers (EPACOE) Manual "Evaluation of Dredged Materials Proposed for Ocean Disposal" February, 1991. Because the procedures presented in this manual are used to determine the acceptability of disposed solids (dredged materials) to surface waters and their sediments, certain procedures were modified to address the toxicity of non-dredged materials; modifications to specific procedures are discussed in the appropriate sections.

2.2 SELECTION OF SEDIMENT SAMPLING STATION AREAS

2.2.1 Selection of Test Station Areas

The following criteria were considered in the selection of proposed test station areas for HPA:

- Proximity to areas of known or potential contamination, specifically IR and PA sites and UST locations identified in previous investigations
- Past historical shoreline and berth uses
- Areas of little or no influence from potential sources of contamination other than HPA
- Accessibility for sampling.

The proposed test station areas were all considered to be accessible sediment sampling areas of little or no influence from potential sources of contamination other than HPA. The stations were placed along the coastal perimeter of HPA from north to south, and in proximity to the HPA areas of known and potential contamination described in Table 1 and the status of confirmed USTs is summarized in Table 2. The 17 proposed stations and associated areas of known or potential contamination are listed below and shown on Plate 3. These locations are approximate and may be changed as more information regarding the hydrogeology of HPA is obtained from the RIs or UST investigations.

Station Number	Associated Site(s)	Outfall(s)
S-1	IR-7, PA-18	B
S-2	IR-6, IR-10	C
S-3	IR-6, IR-10	D
S-4	IR-6	---
S-5	IR-9	G,H,I,J
S-6	IR-8, IR-9	---
S-7	PA-16, IR-17	---
S-8	IR-11, IR-15, PA-16, IR-17	A
S-9	IR-2, IR-11, IR-15	---
S-10	IR-2, IR-3, IR-8, IR-11, IR-14, IR-15	---
S-11	IR-2, IR-5, IR-12, IR-13	---
S-12	IR-2, IR-4, IR-5, IR-12	---
S-13	IR-1, IR-4	---
S-14	IR-1	---
S-15	Dry Docks #2 and #3	---
S-16	S-203, S-209, S-210, S-215	E,F
S-17	Dry Dock #4	---

The EPA/COE (1991) manual describes procedures used for the sampling of sediments from within known dredging sites for use in the solid-phase bioassay and the liquid suspended particulate-phase bioassay. There is no information provided in this manual regarding the placement of sediment sampling stations in areas of potential contamination for use in the bioassays.

2.2.2 Selection of Control Station Area

A control station area will be used, for the purposes of this study, to verify the health of organisms used in the toxicity tests and the acceptability of bioassay test conditions. The

following criteria were considered in the selection of the proposed control station area:

- Area of little or no known contamination based on historical information and knowledge of the area
- Area beyond the tidal influence of HPA; to be determined from review of National Oceanic and Atmospheric Administration (NOAA) tidal maps, if necessary
- Area containing sediments of similar physical characteristics as test (HPA) sediments (e.g. grain size)
- Area containing sediments that are compatible with the needs of the test organisms.

Control sediment samples will be collected from the area in which the test organisms are collected. In the event the test organisms are laboratory brood stock, the control sediment will be purchased from the commercial supplier of the test organisms.

2.2.3 Selection of Reference Station Area

For the purpose of this study, reference station areas will be used as a basis for comparison to evaluate the potential background toxicity of sediments of similar physical characteristics from an area considered to be uncontaminated. The use of a reference station area for comparative purposes is a modification of the EPA/COE (1991) protocol which considers a reference station area to be a potential disposal site for dredged sediment. The following criteria were considered in the selection of the proposed reference station area:

- Area of little or no known influence from potential sources of contamination at HPA based on historical information and knowledge of the area
- Area containing sediments of similar physical characteristics as test (HPA) sediments (e.g. grain size).

San Pablo Bay is proposed as the reference station area for collection of reference sediment to be used in the solid-phase bioassay and the liquid-suspended particulate-phase bioassay. Sediment bioassay data from several locations within the San Francisco Bay have shown San Pablo Bay to be non-toxic relative to a Puget Sound reference site (NOAA, 1988). The proposed reference station area in San Pablo Bay is shown on Plate 6. Sediment utilized in the reference station bioassays will be of comparable grain size to HPA sediments.

Two locations within San Francisco Bay as indicated on Plate 6, are proposed as additional reference station areas for collection of reference sediments to be used in the solid-phase bioassays and the liquid suspended particulate phase bioassay. These reference stations will be used to approximate conditions in the vicinity of HPA, exclusive of contamination contributed by HPA.

2.3 SELECTION, COLLECTION, AND MAINTENANCE OF TEST SPECIES

2.3.1 Selection of Test Species

The following criteria were considered in the selection of proposed test species for use in the modified solid-phase bioassay and the liquid suspended particulate phase bioassay:

- Appropriately sensitive benthic organisms

- o Representative of several taxonomic categories
- o Representative of several ecological habitats; specifically filter-feeding, deposit-feeding, and burrowing
- o Organisms naturally occurring in the San Francisco Bay.

The proposed test species are listed in Table 4 and include the mysid shrimp (*Holmesimysis costata*), a filter or deposit-feeding infaunal crustacean; the marine worm (*Nephtys caecoides*), a burrowing infaunal polychaete; and an amphipod (*Eohaustorius estuarius*), a filter or deposit-feeding infaunal crustacean for the solid-phase bioassays. The oyster (*Crassostrea gigas*) or bay mussel (*Mytilus edulis*) larvae; the mysid shrimp (*Holmesimysis costata*); and the sand dab (*Citharichthys stigmaes*) will be used in the liquid suspended particulate phase bioassays. The proposed test species were selected from among those recommended by the regulatory agencies as appropriate for use in solid-phase and liquid suspended particulate phase bioassays in the San Francisco Bay Area.

2.3.2 Collection of Test Species

Test species will be obtained from a supplier of aquatic organisms. The following procedures will be utilized in the collection of test organisms. Test species will be collected from a known uncontaminated field location where they occur in sufficient numbers for collection of an adequate sample size (1,500 individuals of each species). The temperature and salinity of the waters from which the test organisms are collected will be measured and recorded. The modified solid-phase bioassay and amphipod sediment bioassay will use 20 individuals of each of the three species to be placed in each replicate test container. The liquid suspended particulate phase bioassay will use 10 individuals of each of the three species to be placed in each replicate tank. Test organisms utilized in the bioassays will be of the same age class. Five replicate tanks will be used for each sediment sampling station, for the three reference locations, and for the control station for both the solid-phase and the liquid suspended particulate phase bioassays.

The following materials will be used as necessary collection of the test organisms:

- o Macrophyte net
- o Benthic shovel
- o Sediment sieve - 1.0 millimeter (mm) mesh
- o Water sampler (Van Dorn)
- o Clean holding containers.

The test organisms will be collected with a macrophyte net, or with the sediment in which they naturally occur using a benthic shovel, as appropriate. A benthic shovel refers to an attachment to the macrophyte net that prevents organisms from washing under the bottom of the sampler during the collection of organisms. The benthic shovel digs into the substrate increasing collection yield. The organism-containing sediments will be sieved using a 1.0 mm screen. Test organisms will be identified and counted to be sure sufficient numbers have been collected for use in the bioassay. Because the 10-day bioassay test period can represent a major portion of

the life-span of the mysid shrimp and other species, an attempt will be made to collect only juvenile forms in the same age class for use in the bioassay.

Organisms will be gently transferred to holding containers by hand or with pipettes, taking care to prevent contact with fuels, oils, brass, lead, galvanized metal, cast iron, natural rubber or other potentially contaminated areas. Organisms will be placed in holding containers by species, or by compatible species. The holding containers will a contain thirty millimeter layer of the sieved sediments and several liters of well-aerated seawater from the same location. Following collection, the organisms will be transported to the aquatic bioassay laboratory and transferred to laboratory holding tanks. Because of the high volume of water required for the laboratory holding tanks, prepared seawater will be used (See Section 2.3.3). Collection and handling of the test organisms will be conducted as rapidly and gently as possible.

2.3.3 Maintenance of Test Species

2.3.3.1 Amphipod Processing and Maintenance

Upon arrival at the aquatic bioassay laboratory, the sediment containing the amphipods will be placed in known quantities of sediment into a sorting tray. Healthy organisms will be removed from the sorting tray with a bulb pipette (5-mm opening) and placed in 10-cm diameter finger bowls containing prepared sea water with a salinity similar to the water in which the organisms were collected. The seawater will be made from deionized water and artificial sea salts (See Section 2.5). An approximately 50 millimeter deep layer of 0.5-mm sieved sediment from the collection site (or supplier) will be placed in each bowl.

Each finger bowl will contain 20 amphipods. The amphipods used in the bioassay will be within the same age class. The total number of bowls prepared will provide at least one-third more organisms than are required for the bioassays. The finger bowls will then be submerged in aerated holding tanks containing water of the approximate temperature and salinity as the water from which they were collected. Salinity and temperature will be monitored by refractometer and continuous temperature recorder respectively. The amphipods will be fed with concentrated algae every 24 hours.

2.3.3.2 Processing and Maintenance of Other Test Organisms

Upon arrival at the aquatic bioassay laboratory, the organisms will be transferred from the original holding containers to holding tanks, by species or by compatible species. As stated above, holding tanks will contain prepared sea water of the appropriate salinity made from deionized water and artificial sea salts (See Section 2.5).

Organisms which require the presence of sediments will be placed in a holding tank containing the sieved sediments in which they were collected. Benthic organisms will be placed in holding containers with a minimum sediment layer of 50 millimeters. The tanks will have a biological filtering system to remove waste materials from the organisms. Continuous bubble aeration will be used to maintain the dissolved oxygen content above the minimum level (See Section 2.6.2.6). Water salinity and temperature will be monitored by refractometer and continuous temperature recorder respectively. The organisms will be fed every 24 hours; the polycheates, and the mussels or oysters will be fed with concentrated algae, the mysid with brine shrimp, and the sand dab with tubifex worms. To avoid underfeeding and cannabalism of the mysid shrimp, the test species will be fed in a known amount. The test tanks will be monitored closely and if, after 4 hours, no food is present, the amount of food will be increased. The food

for the organisms will be obtained from a commercial supplier. Holding tanks will be cleaned of leftover food and debris every 24 hours, prior to feeding.

The organisms will be maintained at the same temperature and salinity as the water from which they were collected. Identity of the test organisms will be confirmed by an experienced taxonomist. Because of their greater sensitivity, juvenile forms of the mollusks and large crustaceans will be selected for use in the bioassay where possible. Organism used in the bioassays will be within the same age class. The bioassay will be initiated within fourteen days of faunal collections.

2.4 SEDIMENT SAMPLING PROCEDURES

2.4.1 Surficial Sediment Grab Sampling Procedures

Ten grab samples of surficial sediments will be collected from each of the 17 test station areas shown on Plate 3, and one sediment sample from each of the three reference station areas shown on Plate 6. Sediment samples will be collected from random locations within the station areas shown on Plate 3. Exact locations will depend on field conditions at the time of sample collection. Randomness of sample collection will be accomplished through a combination of boat movement and wind and water currents naturally moving the stern of the boat. If natural factors are insufficient to achieve random sampling, the boat will be relocated within the sediment station area. Loran coordinates will be recorded during collection of each representative grab sediment sample within a sampling station area.

Grab sediment samples will be discarded if they are low in volume (less than 75% of sampler volume) or contain visible foreign objects. Grab samples will be screened for gamma and beta radiation upon collection with an Eberline E120 portable radiation survey meter with a GM pancake probe. Alpha radiation will be screened with an Eberline ESP 1 portable radiation survey meter with scintillation probe AC3-7. Care will be taken to minimize contamination and alteration of the physical and chemical properties of the sample from freezing, air oxidation, or drying.

Ten sediment samples will also be obtained from the control station area. In the event the test organisms are laboratory brood stock, the control sediment will be purchased from the commercial supplier of the test organisms. The ten control station sediments will be screened for background radiation levels. Grain size analysis will be performed on 5 sediment control samples. The control sample with a grain size that is most comparable to the grain size of sediments from HPA will be used in the control station bioassays.

The following materials will be needed for collection and storage of sediment samples for use in the bioassay:

- Noncontaminating sediment grab sampler (Petersen grab)
- Eberline E120 Radiation Survey Meter with GM Pancake Probe
- Eberline ESP 1 Portable Radiation Survey Meter with a Scintillation Probe AC3-7
- Airtight wide mouth polyethylene jars or bags for collection of representative sediment samples to be composited for metal and tributyltin analysis

- o Airtight wide mouth glass jars for collection of representative sediment samples to be composited for SOC, pesticide and PCB analysis
- o 10-liter glass containers for storage and mixing of composited samples
- o Stainless steel stirring rods
- o Clean wide mouth glass jars with teflon-lined screw caps with a minimum volume of 125 mL for collection of sediment samples to be analyzed for SOCs, pesticides and PCBs (one composite sample for each of two analytical methods per station)
- o Clean wide mouth polyethylene jars with teflon-lined screw caps with a minimum volume of 125 mL for collection of sediment samples to be analyzed for metals and tributyltin (one composite sample for each of two analytical methods per station)
- o Clean wide mouth plastic jar with a volume of 1 liter for collection of sediment samples for grain size analysis
- o Clean, heat-treated glass jars with teflon-lined screw caps for collection of sediment samples to be analyzed for total organic carbon
- o Ice chests for preservation and transportation of materials.

The ten grab sediment samples from random locations within each test station area (Plate 3) and one grab sediment sample from each reference station (Plate 6) will be obtained using a Petersen grab sampler. The approximate volume of sediment per grab that will be collected by the Peterson grab is 48 cubic inches. The samples will be screened for radioactivity upon collection using the radiation meter. The samples will be placed in airtight polyethylene or glass jars or bags upon collection and sealed until they are composited.

Because low levels of radioactivity have been reported at HPA (HLA, 1990a), all sediment samples will be screened for total radioactivity upon collection. The radioactivity measurements (alpha and beta particles and gamma rays) will be recorded for the control sediment sample and will be considered the background level. Ten control sediment samples will be screened for radiation in order to calculate the mean background radiation level plus 3 standard deviations. Radioactivity measurements recorded for test and reference sediments will be compared to this background level and to regulatory radiation exposure levels for personal protection. Should radiation levels of test sediments be above the background level, a non-composited sample will be removed, stored appropriately, and submitted for laboratory testing of radioactivity. Should radiation levels of test sediments be greater than regulatory exposure levels for personal protection, further implementation of the ESAP will be discontinued until appropriate modifications can be made which address the issue of radioactivity at elevated levels. No further action will be taken to address radioactivity if sample levels are within background levels.

Grab sediment samples from within a particular station area will be composited in the field by transferring approximately one liter of sediment from each of the ten representative samples to a separate 10 liter container. Infauna will be screened from the sediment using a 0.5 millimeter screen.

When the ten representative samples have all been transferred and the 10 liter container is filled to overflowing, the sediment will be slowly stirred with a stainless steel rod to ensure

adequate mixing. The sediment will be mixed until the color and texture are visually homogenized. Samples for physical and chemical analyses will be removed from the container and the 10 liter container with the remaining portion of the composite sample will be sealed and labeled with the station identification number for use in the bioassay tests. The 10 liter container will be stored immediately in an ice chest at 2 to 4°C and maintained at that temperature until the sediment is utilized in the bioassays. The amphipod sediment bioassay, modified solid-phase bioassay, and liquid suspended particulate phase bioassay will be initiated within fourteen days of sample collection.

Samples of the composites that will be used for analysis of physical parameters (grain size) will be placed in clean, wide mouth, one-liter plastic containers and labeled with the station identification number. Samples of the composites to be used for chemical analyses will be placed in clean, wide mouth, 125 ml polyethylene or glass jars with teflon-lined screw caps which will be completely filled to prevent air bubbles, sealed, labeled with the station identification number, and stored immediately in ice chests at 2° to 4°C and maintained at that temperature until analysis. Samples collected for tributyltin analysis will be frozen within 24 hours of collection. The analyses program for sediment grab samples is discussed in Section 2.7 and summarized in Table 3.

2.4.2 Sediment Core Sampling Procedures

One discrete sediment core sample to a depth of three feet will be collected at each of the 17 test stations shown on Plate 3, and from the two reference station areas in San Francisco Bay (Plate 6). The location of each core sample station will be recorded using Loran C coordinates.

If sediment core samples are low in volume, they will be discarded and the core sample recollected. Core samples will be screened for gamma and beta radioactivity upon collection with an Eberline E120 portable radiation survey meter with a GM pancake probe and for alpha radiation with an Eberline ESP 1 portable radiation survey meter with a scintillation probe. Care will be taken to minimize contamination and alteration of the physical and chemical properties of the sample from freezing, air oxidation, drying, or contact with potential sources of contamination.

The following materials will be utilized for the collection and storage of sediment core samples:

- Eberline E120 Radiation Survey Meter with GM Pancake Probe
- Eberline ESP 1 Portable Radiation Survey Meter with Scintillation Probe AC3-7
- Brass gravity-type core sampler including stainless steel core catchers and nosepiece
- Cellulose acetate buterate (CAB) core liner tubes
- Teflon lined core caps
- Ice chests for preservation and transportation of materials.

Sediment core samples will be collected from each station (Plate 3) using a 2-inch diameter gravity-type corer deployed from a boat. Continuous core samples will be collected to a depth of 3 feet below the sediment-water interface. Water depth at the core sample location and depth of penetration of the cores will be recorded during sampling. Upon retrieval, the CAB

core liner tubes will be extracted from the corer, capped with teflon lined core caps, sealed with tape, labeled and placed on ice in a cooler maintained at 2-4° C. All sampling equipment will be decontaminated prior to and between sampling events within a sampling station by rinsing with clean water (EPA/COE, 1991). Between sample station areas, equipment will be decontaminated by washing with an Alconox detergent solution, followed by a double rinse of tap water followed by distilled water. All proper chain-of-custody protocol will be followed during sample collection and handling as outlined in the Quality Assurance Project Plan (QAPjP).

Discrete core samples at the 30 to 36 inch core interval will be extracted from the cores at the laboratory to avoid potential sample contamination in the field. The laboratory analytical program for sediment samples is discussed in Section 2.7 and summarized in Table 3.

2.5 PREPARATION OF SEAWATER FOR BIOASSAY SYSTEMS

The following materials will be needed for preparation of seawater for use in the bioassay:

- Artificial sea salts (Instant Ocean)
- Deionized water
- Polyethylene storage containers of sufficient volume for static-renewal of solid-phase bioassay test tanks.

Artificial seawater of approximately the same temperature, salinity, and dissolved oxygen content as water at test organism collection sites will be prepared from artificial sea salts and deionized water. Unless otherwise specified by the manufacturer, the artificial sea water will be aged, with aeration, for one week prior to use in the bioassays. If a residue or precipitate is present after aging, the sea water will be filtered, prior to use. Salinity will be maintained within ± 2‰ and temperature within ± 2° C. Salinity adjustments will be made, if necessary, with distilled water (to decrease salinity) or a brine prepared from distilled water and artificial sea salts (to increase salinity). Dissolved oxygen will be maintained above 40% saturation.

The prepared artificial sea water will be used in the wet-sieving procedure described below for addition to test tanks used in the solid-phase bioassay and for use in the liquid suspended particulate phase bioassay test tanks. Static-renewal of the solid-phase bioassay test tanks will be used with seventy-five percent replacement (See Sections 2.6.1.2 and 2.6.2.3 for replacement intervals). The volume required will be approximately 5 liters for each solid-phase bioassay test container, approximately 5 liters for each liquid suspended particulate phase bioassay tank, and several additional liters for use in wet-sieving.

2.6 BIOASSAY TESTING PROCEDURES

2.6.1 Amphipod Sediment Bioassay

2.6.1.1 Sediment Preparation

Just prior to initiation of the bioassay (within 48 hours), preparation of the sediments will be conducted using the following methods:

- Sediments will be removed from the interior of the 10 liter composite sample container

- Sediments will be wet-sieved through a 0.5 mm mesh screen using a small amount of seawater to remove test organisms from the sediment. Water and sediment will be retained in a settling container
- Material retained by the screen will be placed on a sorting tray, organisms will be removed, and the remainder will be returned to the settling container
- Sediment will be allowed to settle for at least 4 hours, after which seawater will be decanted without disturbing surface sediment
- Sediment will be resieved through a 0.5 mm screen into water of the same salinity as the bioassay water
- Sediment will again be allowed to settle for at least four hours, the overlying water decanted, and the sediment held at 12° C until bioassay chambers are prepared.

Prior to initiation of the bioassay, preparation of the test sediments will be conducted using the following methods:

- Interstitial salinity of sediments will be determined by refractometer
- Sediments will be placed in bioassay chambers with overlying water of a salinity calculated to raise interstitial sediments to a minimum of 15 ppt (if necessary)
- Sediments will be slowly stirred by hand with a clean glass rod for one minute, then allowed to settle and equilibrate
- Approximately 75% of the overlying water will be decanted and retained for use in the bioassay
- Sediments will be mixed after reintroduction of the decant water to the test chambers
- Interstitial salinities of each test chamber will be confirmed prior to initiation of the bioassay.

2.6.1.2 Test Chamber Systems

Test chambers to be used in the bioassay will be standard one liter glass beakers (10-cm internal diameter) covered with an 11.4 cm diameter glass watchglass. The bioassay tests will be conducted in a temperature controlled room with an overhead aeration source. Aeration to each beaker will be provided through a one mL glass pipette which extends between the beaker spout and watchglass to a maximum depth of 2 cm from the sediment surface. The dissolved oxygen content will be maintained above 40% saturation. Test water will be gently aerated so as not to disturb the test sediment. Temperature will be maintained within $\pm 2^{\circ}$ C of the temperature of the water from which the organism were collected. Five replicate chambers will be used for each of the 17 test stations, the 3 reference stations, and for the control sediment.

Prepared seawater of approximately similar temperature, salinity and dissolved oxygen content as water from which the organisms were collected will be used for replacement of static water in the test containers. Seventy-five percent of the seawater volume in each container will be replaced one hour before initiation of the bioassays and at 48 hour intervals after that using

gentle siphoning and water introduction techniques. Care will be taken to avoid resuspension of settled materials or test organisms during water replacement. The frequency of replacement will be increased if acceptable water quality cannot be maintained.

2.6.1.3 Introduction of Seawater and Sediments to Test Chambers

Addition of seawater and sediments to test chambers will involve the following procedures:

- Approximately 175 mL of test sediment will be placed in the bottom of the one liter test chamber to create a 2 cm layer of sediment on the bottom
- Sediment in the test chamber will be settled by smoothing with a spoon and bubbles removed by gentle tapping
- Test chambers will be filled to 950 mL with 15 ppt salinity seawater, covered with a watchglass and placed in a temperature controlled room. Sediment disturbance during seawater introduction will be minimized by placement of a disk on the sediment surface.

2.6.1.4 Introduction of Organisms to Test Chambers

Just prior to initiation of the bioassay the following procedures for the preparation of the organisms will be conducted:

- Sediments will be gently siphoned and sieved through a 0.5 mm sieve to recapture the organisms from holding tanks containing sediments
- Organisms will be gently removed from holding tanks containing seawater
- Damage to the organisms will be avoided by handling with extreme care; organisms which appear damaged or do not meet the bioassay criteria described below will be discarded.

Following preparation and selection of individual organisms for use in the bioassay, the selected organisms will be released from the finger bowls to the test chambers (20 per chamber) by placing a disk on the water surface and gently pouring the contents of the finger bowls into the test chamber. The fingerbowl will be washed to remove any remaining organisms. Any amphipods floating on the water surface will be gently submerged with the beaker cover edge. After 1 hour, any organisms that have not buried into the sediment will be removed and replaced.

2.6.1.5 Initiation of Amphipod Sediment Bioassay

The bioassay will begin with the introduction of organisms to the test tanks. Daily records will be kept of the following observations:

- Obvious mortalities (will not be removed from test chambers)
- Number of organisms which have emerged from the sediment (either floating on water surface or lying on top of the sediment)
- Abnormal behavioral responses such as amphipod failing to bury in sediments.

Daily levels of the following water parameters in test chambers will be measured and recorded:

- o Salinity
- o Temperature (a separate beaker will be set up for temperature monitoring purposes)
- o Dissolved oxygen content
- o pH
- o Ammonia concentration.

Gentle aeration will be used to maintain the dissolved oxygen content above 40% saturation. Lighting for the bioassay tanks will consist of fluorescent bulbs to provide continuous light throughout the bioassay.

2.6.1.6 Completion of Amphipod Sediment Bioassay

After 10 days, the test chamber sediments will be siphoned through a 0.5 mm screen. The material retained on the screen will be mixed with clean seawater and searched thoroughly for organisms. The organisms will be considered alive if they show any response to gentle prodding or if pleopod twitch is observed under magnification. The number of dead and live organisms will be counted and recorded. Sublethal effects such as paralysis will be recorded as mortalities if the test organism fails to respond to gentle prodding.

Care will be taken not to count exoskeletons as dead organisms. Organisms which are not recovered will be considered dead because once dead, organisms may decompose or be predated.

2.6.2 Modified Solid-Phase Bioassay for Nephtys caecoides and Holmesimysis costata

2.6.2.1 Sediment Preparation

Just prior to initiation of the bioassay (within 48 hours), preparation of the sediments (solid-phase) will be conducted using the following methods:

- o Sediments will be removed from the interior of the 10 liter composite sample containers
- o Sediments will be wet-sieved through a 0.5 mm mesh screen using a small amount of seawater to remove any remaining live organisms present in the sediment. Water and sediment will be retained in a settling container
- o Material retained by screen will be placed on a sorting tray, organisms will be removed, and the remainder will be returned to settling container
- o Sediment will be allowed to settle for 24 hours, seawater will be decanted without disturbing surface sediment, and sediment will be mixed to ensure homogeneity
- o Sediment will be returned to storage containers and held for approximately 48 hours until needed.

2.6.2.2 Organism Preparation

Just prior to initiation of the bioassay the following procedures for the preparation of the organisms will be conducted:

- Sediments will be gently siphoned and sieved through a 0.5 mm sieve to recapture the organisms from holding tanks containing sediments
- Organisms will be gently removed from holding tanks containing seawater
- Damage to the organisms will be avoided by handling with extreme care; organisms which appear damaged or do not meet the bioassay criteria described below will be discarded
- Specimens of *Nephtys caecoides* and *Holmesimysis costata* will be placed into separate finger bowls with water of the same temperature and salinity and from the same source as the water being used in the test so that each contains 20 individuals of the test species.

2.6.2.3 Test Chamber Systems

Test chambers used in the bioassay will be standard one liter glass beakers (10-cm diameter) covered with an 11.4 cm diameter glass watchglass. At least five replicate containers will be used for the control station, the two reference stations and for each of the 17 test stations.

Prepared seawater of approximately the same temperature, salinity and dissolved oxygen content as water from which the test organism were collected will be used for replacement of static water in the test containers. Salinity will be maintained at ± 2‰ and temperature within ± 2° C. Dissolved oxygen will be maintained above 40 percent saturation. Seventy-five percent of the seawater volume in each container will be replaced one hour before initiation of the bioassays and at 48 hour intervals after that using gentle siphoning and water introduction techniques. Care will be taken to avoid resuspension of settled materials or test organisms during water replacement. The frequency of replacement will be increased if acceptable water quality cannot be maintained.

2.6.2.4 Introduction of Seawater and Sediments to Test Chambers

Addition of seawater and sediments to test container will involve the following procedures:

- Each test container will be partially filled with seawater
- Enough sediment will be added (reference sediment to reference tanks and test sediments to test tanks) to produce an even 2 cm layer on the bottom
- Each tank will be allowed to stand for at least 24 hours
- Seventy-five percent of seawater volume in the test containers will be replaced using gentle siphoning and addition techniques one hour prior to addition of organisms.

2.6.2.5 Introduction of Organisms to Test Chambers

Following preparation and selection of individual organisms for use in the bioassay, the selected

organisms will be released from the finger bowls to the test containers. *Nephtys caecoides* and *Holmesimysis costata* species will be placed in separate test containers.

2.6.2.6 Initiation of Bioassay

The bioassay will begin with the introduction of organisms to the test containers. Daily records will be kept of the following observations:

- o Obvious mortalities (will be removed from test containers)
- o Formation of tubes or burrows
- o Unusual behavioral patterns such as burrowing species not burrowing.

Daily levels of the following water parameters will be measured and recorded:

- o Salinity of tank water
- o Temperature of tank water
- o Dissolved oxygen content of tank water
- o pH of tank water
- o Ammonia concentrations in tank water.

Gentle aeration will be used to maintain the dissolved oxygen content above 40% saturation (EPA/COE, 1991). Lighting for the bioassay tanks is provided by fluorescent bulbs on a timer to simulate natural conditions.

2.6.2.7 Completion of Solid-Phase Bioassay

After 10 days, the tank sediments will be siphoned through a 0.5 mm screen. The material retained on the screen will be mixed with seawater and searched thoroughly for organisms. The organisms will be considered alive if they show any response to the gentle probing of sensitive parts. The number of live organisms will be counted and recorded. Sublethal effects such as paralysis will be recorded as mortalities if the test organism fails to respond to gentle probing.

Care will be taken not to count exoskeletons as dead organisms. Organisms which are not recovered will be considered dead because once dead, organisms may decompose or be predated.

2.6.3 Presentation of Data

According to the 1991 EPA/COE Greenbook, if control mortality is greater than 10 percent, the results of the bioassay are considered invalid. However, statistical analysis may be used to determine the acceptability of results if control mortality is greater than 10 percent. The 1991 EPA/COE manual states that "unacceptably high control mortality indicates that the organisms are being affected by important stresses other than contamination in the material being tested (i.e. injury, disease, unfavorable chemical or physical conditions in test containers, improper handling or acclimation, or unsuitable grain size". In this event, species selection or other

variables will be re-evaluated and the test repeated. If control mortality is acceptable, the bioassay data will be presented in tabular form and will include the following information:

- Scientific name of selected test species
- Water quality measurements during testing (i.e. DO, temperature, salinity, pH, ammonia concentrations)
- Number of animals seeded
- Percent of animals recovered alive
- Unusual behavioral patterns noted during bioassay testing
- Statistical analysis of data if required to determine the acceptability of control mortality.

2.6.4 Statistical Analysis and Interpretation of Results

If control mortality is acceptable, survival of individual species will be statistically analyzed by the following statistical methods. Levene's test for the homogeneity of variances will be performed first to test for the validity of assumptions of normality and constant variance. If Levene's test shows that the data is parametric, the analysis of variance (ANOVA) will be performed. If the results of the ANOVA show a statistically significant difference between the group means, the means will be tested with Dunnett's Test. If Levene's test shows that the data are non-parametric (does not satisfy ANOVA assumptions of normality and constant variance), a non-parametric test (i.e. Kruskal-Wallis test) will be performed for comparison, followed by a Wilcoxin test, if necessary. Other statistical analysis of data will be considered where appropriate.

A statistically significant effect in a bioassay does not necessarily imply that the same impact would occur in the field. There is no quantitative method for estimating ecological effects in the field from the results of a bioassay. Statistical analysis of benthic bioassay data will be conducted to determine the 'strength of evidence' for concluding that the test samples are significantly more toxic to marine benthic infauna than are the control sediment samples. However, differences between control and test survival should be 10 percent or greater before predictions of probable field impact can be made (EPA/COE, 1991).

2.6.5 Liquid Suspended Particulate Phase Bioassay

2.6.5.1 Sediment-Water Preparation

Prior to initiation of the liquid suspended particulate phase bioassay, preparation of the sediment-water mixture will be conducted using the following methods:

- One liter sediment subsamples will be removed for each of the composite sample containers
- The sediments will be combined with prepared artificial seawater in a volumetric sediment-to-water ratio of 1:4 at room temperature (22° ± 2° C)
- The sediment-seawater mixture will be thoroughly mixed for 30 minutes

- o The mixture will then be allowed to settle for 1 hour
- o The liquid and sediment remaining in suspension after 1 hour will be siphoned off, taking care not to disturb the settled material, for immediate use in the bioassay.

2.6.5.2 Organism Preparation

Just prior to initiation of the liquid suspended particulate phase bioassay, the following procedures will be conducted:

- o From holding tanks containing seawater, organisms will be gently removed by pipette. Larger organisms will be transferred in fine-mesh nets.
- o Damage to the organisms will be avoided by handling with extreme care; organisms which appear damaged or that exhibit abnormal behavior will be discarded
- o Specimens of the three species of approximate equal size will be randomly divided into test containers so that each contains 10 individuals of each test species.

2.6.5.3 Test Tank System

Tanks to be used in the liquid suspended particulate phase bioassays will have a volume of at least 5 liters. At least five replicate tanks will be used for the control station, the three reference stations and for each of the 17 test stations. More tanks may be used to separate potential predator and prey species.

Prepared seawater of approximately the same temperature, salinity and dissolved oxygen content as the water from which the test organisms were collected will be used for the sediment-water mixture. Salinity will be maintained at ± 2‰ and temperature at ± 2° C. A dissolved oxygen content of 40 percent saturation or greater will be maintained throughout the tests.

Three concentrations of test material suspension will be tested at concentrations of 100, 50, and 10 percent.

2.6.5.4 Introduction of Seawater-Sediment Mixture to Test Tanks

The 1:4 sediment-water mixture will be introduced to the test tanks immediately upon completion of the sediment/water preparation procedures described in Section 2.6.2.1.

2.6.5.5 Introduction of Organisms to Test Tanks

Following preparation and selection of individual organisms for use in the bioassay, the organisms will be released to the tanks. Potential predator and prey organisms will be placed in separate tanks.

2.6.5.6 Initiation of Liquid Suspended Particulate Phase Bioassay

The bioassay will begin with the introduction of organisms to the test tanks. The test duration will be 48 hours for bivalve larvae and 96 hours for the mysid shrimp and sand dab.

At 0, 4, 24, 48, 72 and 96 hours, the number of live organisms will be recorded. An organism

will be considered dead if it does not respond to the probing of a sensitive body part and will be removed from the test tank. In addition, any behavioral abnormalities exhibited by test organisms will be recorded. At each observation period, dead organisms, molted exoskeletons and food debris will be removed from the tanks by pipette or forceps.

Daily levels of the following water parameters will be measured and recorded:

- o Salinity of tank water
- o Temperature of tank water
- o Dissolved oxygen content of tank water
- o pH of tank water.

The tank water will be aerated only when necessary to maintain the dissolved oxygen content above 40% saturation (EPA/COE, 1991).

2.6.5.7 Completion of Bioassay

After 48 hours, the tank water containing the bivalve larvae will be searched thoroughly for organisms. The organisms will be considered alive if they show any response to the gentle probing of sensitive parts or gently swirling of the water. The number of live organisms will be counted and recorded. After 96 hours, the same procedures will be performed on the tank test water containing the mysid shrimp and sand dab.

2.6.5.8 Presentation of Data

If control mortality is greater than 10 percent (20 percent for zooplankton and larvae), the results of the bioassay may not be evaluated. In this case, species selection and other test variables will be reevaluated in an attempt to reduce unacceptably high control mortality. If control mortality is less than 10 percent, the bioassay data will be presented in tabular form and will contain the following information:

- o Scientific name of test species
- o Number of organisms in each treatment at test start
- o Number of organisms alive at each observation period
- o Number of organisms recovered alive at test end
- o Any behavioral abnormalities recorded

2.6.5.9 Statistical Analysis and Interpretation of Results

If control mortality is less than 10 percent (20 percent for larvae) and is less than the mortality in the test material treatment, the test data will be statistically analyzed to determine if there is a significant difference in survival between control and test samples. The t-test (Snedecor and Cochran, 1980) will be used to compare the mean control and test survivals following the Levene's test for the homogeneity of sample variances.

If mortality in the test material exceeds 50 percent, an LC50 value (lethal concentration to 50 percent of the sample) will be calculated for any dilutions in which greater than 50 percent mortality occurs.

In the event that no mortality occurs in either control or test tanks, or that survival of organisms in the test tanks is equal to or greater than control organism survival, no statistical analyses will be performed (EPA/COE, 1991).

2.7 CHEMICAL ANALYSIS CONFIRMATION

Chemical analysis will be conducted on composite surficial samples and a discrete sediment core sample from each test station to provide information regarding contaminants in the sediments that, if present and biologically available, could cause toxicity. Collection, preservation, and storage of the sediment samples which may be used for analysis are described in Section 2.4. The analytical program is presented in Table 3. Field and laboratory Quality Control (QC) information is contained in the Quality Assurance Project Plan (QAPjP).

The sediment samples will be analyzed for both inorganic and organic constituents. A list of the analytical methods, analyte list, and approximate quantitation limits are presented in Table 5. The classes of target chemicals for analysis include inorganics, pesticides and PCBs, SOCs, and tributyltin. Sediment core samples will also be analyzed for VOCs. Both sediment grab and core samples will be analyzed for grain size distribution and total organic carbon to facilitate comparison among samples. These analyses will be performed in accordance with the procedures outlined in the EPA Contract Laboratory Program (CLP) Statements of Work (SOWs) (EPA, 1988a,b). If CLP detection limits exceed sediment contaminant levels associated with adverse biological effects (ER-L values), lower detection limits will be used (See Table 5).

Sediment core samples will be sent to a CLP laboratory(s) immediately following collection where they will then be split in preparation for the various chemical analyses. Sediment grab samples will be split and sealed in appropriate containers in the field. Laboratories utilized for chemical analysis will meet the CLP requirements and standards for equipment, personnel, laboratory practices, analytical operations and quality control operations and follow CLP standard protocol. The laboratory(s) will also be certified by the State of California Department of Health Services and the Naval Energy and Environmental Support Activity.

Sediment analysis for metals will utilize inductively coupled plasma (ICP) by the CLP metal method, with the exception of arsenic, total lead, selenium, and thallium to be analyzed by furnace atomic absorption (AA) and mercury by cold vapor AA, using CLP metal methods. Semi-volatile organic compounds will be analyzed using GC/MS CLP SOC methods, and pesticides and PCBs by GC using the CLP pesticide/PCB method. Sediment samples will be analyzed for total organic carbon by EPA Method 9060.

Tributyltin will be analyzed by n-pentyl derivitization with gas chromatography/flame photometric detection (GC/FPD) (Uhler, 1989). This method requires that the samples be frozen within twenty-four hours of collection. Analysis for tributyltin will be performed within the 28 day holding time.

2.8 SEDIMENT GRAIN SIZE ANALYSIS

Sediment grain size analysis will be conducted on composite surficial samples and a discrete core sample from each test station. Collection, preservation, and storage of the sediment

samples which may be used for the analysis are described in Section 2.4. The analytical program is presented in Table 3.

The sediment samples will be analyzed for grain size using ASTM Method D422. Sediment samples to be analyzed for grain size will be sent, immediately following collection, to a laboratory for analysis.

2.9 QUALITY ASSURANCE SUMMARY

Provisions for quality assurance will be made where applicable and specifically in the following areas:

- Organisms selected for use in the bioassay will be undamaged and positively identified to species
- Laboratory and bioassay temperature control equipment will be adequate to maintain required test temperature
- Instruments used for measurement of test parameters will be calibrated and standardized.
- Sediment will be collected from a control location and processed through the bioassay in five replicates to provide a basis for quality assurance
- A 10 percent or greater average control mortality (less than 90 percent survival) will invalidate the bioassay results unless statistical analysis shows control mortality greater than 10 percent to be valid; because the 10-day bioassay test period can represent a major portion of the life span of the mysid shrimp and other species, and result in mortality greater than 10 percent from natural causes, an attempt will be made to collect only juvenile forms for use in the bioassay
- Field quality assurance/quality control (QA/QC) sample types will include external spikes, blanks, and duplicates as described in the QAPjP
- All chemical analyses will be performed by an EPA CLP-qualified laboratory certified by the State of California, and the Navy for the specific analyses requested, as applicable.

3.0 TASK 2 - EVALUATION OF WHETHER PERSISTENT AND BIOACCUMULATIVE SUBSTANCES MAY BE ENTERING THE SAN FRANCISCO BAY FROM HPA

3.1 STATEMENT OF PURPOSE

The ESAP identifies the procedures to be used for the evaluation of persistent and bioaccumulative substances which may be present in the waters surrounding HPA above background levels. Certain substances present in the groundwater and soil at HPA from past activities are of concern due to their physical persistence and potential for seepage into the San Francisco Bay at concentrations not detectable in the water column itself. The proposed sampling and analytical program is presented in Table 3. Specific substances of concern to be analyzed and their expected reporting limits are presented in Table 6 and include: metals, SOCs, organochlorine pesticides and PCBs, and tributyltin.

The potential presence of these substances in the San Francisco Bay surrounding HPA, and their potential for bioaccumulation into aquatic organisms will be evaluated by measuring the chemical uptake of these substances into the mussel, *Mytilus californianus*. Mussels collected from an uncontaminated area in Bodega Head will be transplanted in the waters surrounding HPA and collection and subsequent chemical analysis of the mussel tissues will provide an indication of which potential persistent and bioaccumulative substances are present.

Two 30-day mussel deployments will be conducted; one in August/September to assess potential bioaccumulative effects during dry weather conditions, and one in January/February to assess potential bioaccumulative effects during wet weather conditions. The May-June mussel spawning period will be avoided in order to maximize mussel bioaccumulative potential. The protocol and methodologies employed in the two mussel deployment test periods will otherwise be identical.

Because low levels of radioactivity have been reported at HPA (HLA, 1990a), all mussel tissue samples will be screened for alpha, beta and gamma radioactivity upon collection (See Section 3.5). Radioactivity measurements will be compared to the background levels. Background levels will be determined by measuring radiation levels in mussels collected from Bodega Bay prior to their deployment. A minimum of ten mussel samples from Bodega Bay will be screened for alpha, beta, and gamma radiation in order to calculate the mean radiation level plus 3 standard deviations. Should the results of the radioactivity screen of mussels following deployment show radiation levels greater than background, samples will be submitted to a radiation-certified analytical laboratory for analysis of radioactivity. Should the results of the radioactivity screen show levels greater than regulatory exposure levels, further implementation of the ESAP will be discontinued until appropriate modifications can be made which address the issue of radioactivity at these elevated levels. No further action will be taken to address radioactivity if sample levels are within background levels.

Collection, deployment, preparation and analytical procedures to be used are based on the "State Mussel Watch Protocol: Procedural Guidelines for Sampling, Analyzing, and Reporting Trace Metal and Synthetic Organic Concentrations in Marine Mussels", Appendix D of "California State Mussel Watch 1983-84" State Water Resources Control Board, Water Quality Monitoring Report No. 85-2WQ, 1985, and the "California State Mussel Watch 1986-1987" State Water Resources Control Board, Water Quality Monitoring Report No. 88-3, July, 1988.

Because the SMW procedures are designed for a long-term monitoring study used to identify trends in toxic pollutants (SWRCB 1985, 1988), certain modifications were necessary to address the short-term qualitative focus of this mussel study; i.e. the *presence* of persistent and

bioaccumulative substances from HPA. Modifications to specific procedures are discussed in the appropriate sections.

3.2 SELECTION OF MUSSEL TRANSPLANT STATIONS

The following criteria were considered in the selection of proposed mussel transplant stations for HPA:

- Proximity to areas of known or potential contamination, specifically IR and PA sites and UST locations identified in previous investigations
- Areas closer to shoreline than sediment sampling stations to address potential groundwater seepage, direct surface water runoff, and/or discharge from storm sewer outfalls
- Past historical shoreline and berth uses
- Areas of little or no influence from potential sources of contamination other than HPA
- Accessibility for transplant and retrieval of mussels.

The proposed mussel transplant stations were all considered to be accessible transplant and retrieval areas near potential sources of contamination at HPA. The stations were placed along the coastal perimeter of HPA from north to south, in proximity to the HPA areas of known and potential contamination described in Table 1 and the status of confirmed USTs is summarized in Table 2. The 17 proposed mussel transplant stations and associated areas of known or potential contamination are listed below and shown on Plate 4. These locations are approximate and may be changed as more information regarding the hydrogeology of HPA is obtained from the RIs or UST investigations.

Station Number	Associated Site(s)	Outfall Areas
M-1	IR-7, PA-18	B
M-2	IR-6, IR-10	C
M-3	IR-6, IR-10	D
M-4	IR-6	---
M-5	IR-9	G,H,I,J
M-6	IR-8, IR-9	---
M-7	PA-16, IR-17	---
M-8	IR-11, IR-15, PA-16, IR-17	A
M-9	IR-2, IR-11, IR-15	---
M-10	IR-2, IR-3, IR-8, IR-11, IR-14, IR-15	---
M-11	IR-2, IR-5, IR-12, IR-13	---
M-12	IR-2, IR-4, IR-5, IR-12	---
M-13	IR-1, IR-4	---
M-14	IR-1	---
M-15	Dry Dock # 2	---
M-16	Dry Dock #3	E,F
M-17	Dry Dock #4	---

In addition, mussels will be deployed at two reference stations located in San Francisco Bay as indicated on Plate 7.

The SWRCB (1985, 1988) SMW reports describe procedures used for the transplant to, and retrieval of mussels from, sites throughout the San Francisco Bay. The focus of the SMW Program has changed from "clean" sites to problem areas (SWRCB, 1985), but no particular guidance is provided regarding the placement of mussel transplant stations in areas of potential contamination.

3.3 SELECTION OF TEST SPECIES

The following criteria were considered in the selection of test species for use in this mussel study:

- Ease of collection; availability from an uncontaminated area
- Ease of transplant
- Native to Northern California
- Can be used in bays and estuaries.

The proposed test species is the California mussel, (*Mytilus californianus*) as presented in Table 4. Only healthy, non-spawning mussels will be used as test organisms.

3.4 DETERMINATION OF SIZE OF TEST POPULATION

Because no statistical analysis is necessary for determination of the presence of chemicals in tissue, the size of the test population is dependent on the number of mussel deployment stations, the number of mussels required for each analysis, and the number of analyses to be completed.

Each mussel deployment station will have a sample size of 50 (15 composited individuals for a single analysis of trace metals, 20 composited individuals for a single analysis of organic compounds, 5 composited individuals for field screening of radioactivity, and 10 individuals to compensate for potential mortality among the test mussels). Subsequent laboratory testing of radioactivity will be conducted should levels be above the established background radioactivity level (See Section 3.5). The use of composited samples and the numbers of composited individuals used for the respective analyses are consistent with the SMW Program (SWRCB, 1988). The 20 composited individuals is the minimum for analysis of organic compounds. For statistical purposes, the SMW program uses three replicates of 15 composited individuals for trace metal analysis (SWRCB, 1988).

3.5 COLLECTION OF MUSSELS FROM UNCONTAMINATED AREA

Tissue concentrations of certain metals and organics show a distinct correlation with the size of the mussel; concentrations decrease with increasing mussel size. Mussels collected for transplant will be between 55 and 65 mm in length which is the standard size used by the SMW Program (SWRCB, 1988). The mussel shell length will be measured and recorded upon collection for size requirement verification and for later determination of visible growth following mussel deployment. The habitat height of the mussels, with respect to mean low tide, can be another source of tissue concentration variability. In keeping with SMW procedures (SWRCB, 1988), the mussels for transplant will be collected from the highest tidal height where they can be found in sufficient numbers.

The closest source of transplant mussel stock used by the SMW Program is Bodega Head (SWRCB, 1988). Because this is public property, mussels will be collected in the Bodega Head area. Enough mussels will be collected for transplanting to test and reference stations as well as analyses of a background sample of mussels from the collection area.

The following materials will be needed for collection of mussels for immediate analysis to establish background radioactivity level and background body burden and provide a basis for quality assurance:

- Eberline E120 Radiation Survey Meter with GM Pancake Probe
- Eberline ESP 1 Portable Radiation Survey Meter with a Scintillation Probe AC3-7
- Polyethylene ZIPLOCK® bags (4 mm thickness) cleaned with the detergent MICRO® and thoroughly rinsed with deionized water prior to use
- Aluminum foil bags (constructed from two layers of "heavy duty" aluminum foil) cleaned by heating to 500° C or by rinsing in hexane prior to use
- Polyethylene ZIPLOCK® bags
- Black grease pencils
- Non-metallic ice chests containing dry ice.

A group of 15 individual mussels to be analyzed for metals will be placed in pre-cleaned polyethylene ZIPLOCK® bags. These bags will then placed inside two additional polyethylene ZIPLOCK® bags. A group of 20 individual mussels to be analyzed for organics will be placed in pre-cleaned aluminum foil bags which will then be double-bagged with polyethylene ZIPLOCK® bags. A group of 5 individual mussels will be opened, screened for radioactivity using a radiation meter, and placed in pre-cleaned polyethylene ZIPLOCK® bags for laboratory testing of radioactivity. A minimum of 10 mussels will be screened for alpha, beta, and gamma radiation using a radiation meter in order to calculate the mean background radiation level plus 3 standard deviations. This mean background radiation level will be used as the background level for comparison with radiation levels in mussels following deployment.

Using black grease pencils, the outer bags will be clearly marked with program identification, station identification number, site description, depth of water, date of collection, species, type of analysis to be performed, and the initials of the collector. Samples will be placed in ice chests containing dry ice, quickly frozen, and stored at or below -20° C until preparation and analysis (See Sections 3.8 and 3.9).

The following materials will be needed for collection of mussels for transplant to the test and reference stations:

- Clean nylon mesh bait bags (76 mm x 760 mm with 1/2 inch square mesh) washed with detergent and rinsed with deionized water prior to use
- Nylon cable ties
- Non-metallic ice chests (unfrozen).

Mussels will be collected in the field using the criteria presented above. They will be added to the nylon mesh bait bags in groups of 7-8 individuals. The groups will be separated by constricting the bag with nylon cable ties which permits equal water exposure for all the mussels. The mussel-filled bags will tied off with nylon cable ties and placed in the unfrozen ice chests containing water from the mussel collection site and held for no longer than 48 hours before deployment. Care will be taken to avoid contamination.

3.6 DEPLOYMENT OF COLLECTED MUSSELS

The following materials will be needed for deployment of collected mussels:

- Polyethylene gloves
- Polyethylene ZIPLOCK® bags
- Nylon cable ties
- Buoy systems (described below).

Collected mussels will be stored in unfrozen ice chests for no longer than 48 hours prior to deployment in the field. Field precautions will be taken to avoid contamination from sources such as boat exhaust.

Polyethylene gloves will be worn during deployment of mussels. Mussels in mesh bags will be placed in polyethylene bags from the time they are removed from the ice chests until they are deployed.

Loran coordinates will be recorded to identify deployment locations. Mesh bags containing mussels will be attached with nylon cable ties and deployed in shallow water (less than 9.0 meters in depth) on a securely anchored buoy system. The buoy system will consists of an earth anchor, a polypropylene line or a cable, and an inflatable subsurface float.

The transplant period will be a minimum of 30 days based on American Society for Testing and Materials (ASTM) standard practice for bioconcentration tests which uses fish and bivalve mollusks and requires an exposure duration of at least 28 days (ASTM, 1988). Exposure periods much greater than 30 days may produce significant artifacts in the tissues which would mask the potential chemical releases being investigated at HPA. The SMW Program uses transplant intervals of from two to six months due to the monitoring objectives of their study (SWRCB, 1988).

3.7 RETRIEVAL AND STORAGE OF TRANSPLANTED MUSSELS

The following materials will be needed for retrieval and storage of transplanted mussels:

- Polyethylene gloves
- Eberline E120 Radiation Survey Meter with GM Pancake Probe
- Eberline ESP 1 Portable Radiation Survey Meter with a Scintillation Probe AC3-7
- Polyethylene ZIPLOCK® bags

- Polyethylene ZIPLOCK® bags (4 mm thickness) cleaned with the detergent MICRO® and thoroughly rinsed with deionized water prior to use
- Aluminum foil bags (constructed from two layers of "heavy duty" aluminum foil) cleaned by heating to 500°C or by rinsing in hexane prior to use
- Black grease pencils
- Non-metallic ice chests containing dry ice.

Retrieval from the subsurface buoy system will occur after the 30 day transplant period has elapsed. Polyethylene gloves will be worn during all phases of retrieval and storage. All mussel samples will be placed in polyethylene bags before being brought to the air/water surface to avoid potential contamination by substances floating on the water surface or by boat exhaust.

Samples to be screened for radioactivity will have the shells opened to allow screening of tissues. The gullets will be sliced open to expose the GI tract contents. Radioactivity measurements will be recorded and samples will be placed in pre-cleaned ZIPLOCK® polyethylene bags for potential laboratory testing of radioactivity.

Once brought to shore, the samples to be used for metals analysis will be placed in pre-cleaned ZIPLOCK® polyethylene bags (4 mm thick). This bag will then be placed inside two additional polyethylene ZIPLOCK® bags. Samples to be analyzed for organics will be placed in pre-cleaned aluminum foil bags which will then be double-bagged with polyethylene ZIPLOCK® bags.

Using black grease pencils, the outer bags of all samples will be clearly marked with program identification, station identification number, site description, depth of water, date of collection, species, type of analysis to be performed, and the initials of the collector. Samples will be placed in the ice chests containing dry ice, quickly frozen, and stored at or below -20°C until analysis.

3.8 PREPARATION OF MUSSEL TISSUES FOR ANALYSES

3.8.1 Preparation of Tissues for Metals Analyses

The preparation of mussel tissues for metals analyses will be conducted under minimal contamination conditions. The equipment and glassware cleaning procedure recommended for metals analyses by the SMW Program (SWRCB, 1988) will be used and is presented in Appendix B.

The following materials will be needed for dissection and homogenation of mussels for metals analyses:

- Polyethylene gloves
- Deionized water
- Polyethylene trays
- Stainless steel scalpels (cleaned with MICRO® prior to use)
- Polypropylene jars (4 ounce, acid-cleaned and preweighed)

- o Metric ruler
- o Homogenizing flasks (acid-cleaned)
- o Homogenizer (with stainless steel shaft and blade cleaned with hot nitric acid (HNO_3) and rinsed with deionized water).

The following procedures for dissection and homogenation of mussels for metals analyses will be employed:

- o All handling of mussels during preparation will be conducted wearing polyethylene gloves
- o Frozen mussels will be removed individually from ZIPLOCK® bags and cleaned of epiphytic organisms and debris under running deionized water
- o Mussels will be placed on clean polyethylene trays and allowed to thaw
- o The adductor muscle will be severed and gonads removed with a clean stainless steel scalpel
- o Remainder of soft part of mussel will be placed in polyethylene jar and weighed
- o Shell will be measured and any visible growth of transplanted mussels noted
- o Soft part will be transferred to homogenizing flask and homogenized for three minutes
- o Homogenized sample will be refrozen and stored at-20° C until analysis.

Note that gonads will be removed from samples intended for metals analyses because concentrations of metals in gonads vary with organism sex (Alexander and Young, 1976; Gordon et al, 1978; Stephenson et al, 1987)) and with mass of gonad (Ouellette, 1978). This practice is employed by the SMW Program (SWRCB, 1988).

3.8.2 Preparation of Tissues for Organic Analyses

The preparation of mussel tissues for organic analyses will be conducted under minimal contamination conditions. The equipment and glassware cleaning procedure recommended for organic analyses by the SMW Program (SWRCB, 1988) will be used and is presented in Appendix B.

The following materials will be needed for dissection and homogenation of mussels for organic analyses:

- o Polyethylene gloves
- o Deionized water
- o Sheets of hexane-rinsed aluminum foil
- o Stainless steel scalpels (cleaned with MICRO® detergent prior to use)
- o Glass jars (4 ounce, acid-cleaned and preweighed)

- o Metric ruler
- o Homogenizing flasks (acid-cleaned)
- o Homogenizer (with stainless steel shaft and blade cleaned in hot HNO_3 and rinsed with deionized water).

Mussels will be dissected and homogenized using the same procedures described in Section 3.8.1 with the following exceptions:

- o Thawing and dissection will be conducted on sheets of hexane-rinsed aluminum foil
- o Gonads will not be removed (will be included in analyses)
- o Soft parts will be placed in clean glass jars.

3.9 PREPARATION OF SAMPLES AND ANALYSES

CLP requirements are not applicable for the analysis of tissue, therefore, the methods identified below will be used for analysis of the mussel tissues.

3.9.1 Preparation of Samples and Metals Analysis

Sample digestion prior to analysis of metals other than mercury will be conducted following procedures used by the SMW Program (SWRCB, 1988) (See Appendix C). Sample digestion and analytical procedures for mercury are described below.

Analysis of the metals listed above will be conducted using the inductively coupled argon plasma (ICP) instrumentation, EPA Method 6010, with the exception of selenium, arsenic, total lead and thallium which cannot be analyzed by ICP methods and will be analyzed by graphite furnace atomic absorption (AA) (EPA Method 7000 series). The expected reporting limits are presented in Table 6. This analytical procedure differs from those used by the SMW Program (SWRCB, 1988). The SMW Program utilizes either flame AA or graphite furnace AA methodology (EPA Method 7000 series) for metal analysis with the exception of mercury which is analyzed by cold vapor AA. However, due to the increased number of metal analytes in the ESAP, the ICP was considered as a more appropriate methodology.

3.9.2 Preparation of Samples and Mercury Analysis

Sample digestion prior to analysis of mercury will be conducted following procedures used by the SMW Program (SWRCB, 1988) (See Appendix C). The Stainton (1971) syringe procedure used by the SMW Program, or a similar procedure, will be used for the transfer of nanogram quantities of mercury vapor for analysis by AA spectrophotometry (See Appendix C).

The cold vapor AA technique, EPA Method 7471 (EPA, 1986), will be used for analysis of mercury based on the standard nature and commercial availability of this method. The expected reporting limit is presented in Table 6. The SMW Program (SWRCB, 1988) uses flameless AA techniques similar to the selected method.

3.9.3 Preparation of Samples and Organic Analyses

Homogenized samples will be extracted for organic analyses according to procedures of the Food and Drug Administration (FDA) (1970) which are used by the SMW Program (SWRCB, 1985) (See Appendix C).

The samples will be analyzed for the presence of SOCs by GC/MS techniques, EPA Method 8270 (EPA, 1986), and for the presence of organochlorine pesticides and PCBs by ECD and GC techniques, EPA Method 8080 (EPA, 1986). The expected reporting limits are presented in Table 6. These analytical methods are similar to those used by the SMW Program (SWRCB, 1988).

3.9.4 Preparation of Samples and Tributyltin Analysis

Homogenized samples will be extracted for analysis of tributyltin according to the procedures used by the SMW Program (SWRCB, 1988) (See Appendix C).

The samples will be analyzed for the presence of tributyltin by n-pentyl derivitization followed by gas chromatography/flame photometric detection (GC/FPD) (Durell, 1989). The expected reporting limit is presented in Table 6. This method differs from that used by the SMW Program (SWRCB, 1988).

3.10 PRESENTATION OF DATA

A list of constituents detected by the particular methods and expected reporting limits are presented in Table 6. Results of metals and organic analyses will be presented in tabular form.

3.11 QUALITY ASSURANCE SUMMARY

Provisions for quality assurance will be made where applicable and specifically in the following areas:

- Most proposed procedures follow those employed by the SMW Program (SWRCB, 1988); the number of individuals to be pooled for composite samples is within the ranges used by the State Program although the use of one replicate instead of three for metals analyses is a modification based on the objective of determining the presence of chemicals versus statistical differences

- Mussels will be collected from the uncontaminated area, pooled in the appropriate numbers and stored at the appropriate temperature prior to analysis; the analysis will establish background body burden and provide a basis for quality assurance

- Analysis of most metals will be conducted using ICP instead of AA techniques; analysis of organics will be accomplished using GC/MS instead of GC where possible to provide a greater degree of accuracy

- All chemical analyses will be performed at qualified analytical laboratories which maintain the documentation necessary for appropriate QA/QC.

4.0 TASK 3 - EVALUATION OF STORM WATER RUNOFF TOXICITY

4.1 STATEMENT OF PURPOSE

The ESAP establishes the procedures to be used for the evaluation of the potential toxicity of storm water runoff from HPA. This will be accomplished using chronic bioassay techniques on three appropriate species. Chronic bioassay testing is more sensitive than acute toxicity testing and will address potential toxic effects of exposure to HPA storm water runoff. Chemical analysis of storm water runoff will also be performed to determine contaminant concentrations in storm water from HPA.

Encroachment of bay water to the HPA storm sewer system was identified by HPA personnel following the Loma Prieta earthquake on October 17, 1989 (HLA, 1991). Therefore, the salinity of waters within the storm sewer system could potentially be higher than might normally be expected. Storm water salinity will be measured in the field by refractometer at the time of sample collection. The species selected for use in the chronic bioassays will be those considered most appropriate for the salinities encountered. If higher storm water salinities are measured (>5 parts per thousand), estuarine or marine species, with a tolerance for salinity will be utilized, as opposed to the freshwater species commonly used for this type of effluent toxicity testing.

Collection of storm water samples for use in the chronic bioassays will be conducted concurrently with the storm water sampling for chemical analysis and will allow direct comparison between toxicity data and chemical data for specific storm water sampling points. Collection of bay water samples for chemical analysis and use in the chronic bioassays will be conducted to provide a basis for comparison with the storm water samples. The proposed sampling and analytical program is presented in Table 3.

The following procedures are based on "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms", Weber, C.I., Horning, W.B., et al, eds., Environmental Monitoring and Support Laboratory, Cincinnati, Office of Research and Development, EPA/600/4-87/028, May, 1988 or "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms", Horning, W.B., II and Weber, C.I., eds., Environmental Monitoring and Support Laboratory, Cincinnati, Office of Research and Development, EPA/600/4-85/014, December, 1985. The methodologies are the same as those employed by the San Francisco Bay Regional Water Quality Control Board (RWQCB) for dischargers for effluent toxicity under the NPDES program.

4.2 SELECTION OF SAMPLING POINTS

4.2.1 Selection of Storm Water Runoff Sampling Points

The following criteria were considered in the selection of proposed storm water runoff sampling points for HPA:

- Proximity to or contribution of discharge from areas of known or potential contamination, specifically IR and PA sites identified in previous investigations
- Known discharge point identified in the HLA draft Water Quality Investigations of Stormwater Drainage (1991)
- Representative of "worst-case" storm water runoff from past activities at HPA

- o Accessibility for collection of adequate quantities of storm water for use in the chronic bioassays.

The proposed storm water runoff sampling points for the ESAP are accessible and are the same as those already used for the HLA study of stormwater quality (HLA, 1991). The sampling points are each located in a separate storm water drainage area and, with the exception of location ST4, are considered to be in proximity to or have contribution from the HPA areas of known and potential contamination described in Table 1. Sampling point ST4 is located where alleged discharge of industrial waste was reported to have occurred in the past. The four proposed storm water runoff sampling points and associated areas of known or potential contamination are listed below and shown on Plate 5.

Station Number	Associated Site(s)
ST1	IR-6
ST2	IR-9
ST3	IR-1, IR-2, IR-3, IR-4, IR-5, IR-11, IR-12, IR-13, IR-14, IR-15, IR-17
ST4	Previous Industrial Discharge

The effluent sampling point used for collection of water for the chronic bioassays should usually be the same as that specified in an NPDES discharge permit (EPA, 1985). No particular guidance is provided regarding the selection of storm water runoff sampling points for use in chronic bioassay testing.

4.2.2 Selection of Bay Water Sampling Points

The following criteria were considered in the selection of proposed bay water sampling points for HPA:

- o Point of bay water encroachment to the HPA storm sewer system (outfall location)
- o Accessibility for collection of large quantities of bay water for use in the chronic bioassays

The proposed bay water sampling points for the ESAP are accessible points of bay water encroachment to the HPA storm sewer system. The four proposed bay water sampling points and associated storm water runoff sampling points are listed below and shown on Plate 5.

Station Number	Associated Runoff Station
B-1	ST1
B-2	ST2
B-3	ST3
B-4	ST4

The bay water samples will be utilized as a comparative reference for salinity measurements, bioassay mortality and chemical analytical results for the storm water samples.

4.2.3 Selection of Reference Water Sampling Point

The following criteria were considered in the selection of the proposed reference water sampling point:

- o Area of little or no known contamination based on history and knowledge of the area
- o Area out of the tidal influence of HPA; to be determined from review of NOAA tidal maps, if necessary
- o Area containing water of the same or similar salinity as the receiving waters at HPA.

The proposed reference water sampling point is San Pablo Bay. San Pablo Bay is considered to be an uncontaminated area out of the tidal influence of HPA with an expected salinity similar to the receiving waters at HPA (estuarine). The reference water sample will be collected and prepared for use in the reference bioassays to simulate the encroachment of bay water to the HPA storm sewer system and presence in storm water samples (See Section 4.4.3).

4.3 SELECTION OF TEST SPECIES

The following criteria were considered in the selection of test species for use in the chronic bioassays:

- o Appropriately sensitive species
- o Representative of several taxonomic categories
- o Representative of several ecological niches
- o Commonly used for chronic bioassay testing.

As indicated in Table 4, the species selected for use in the chronic bioassays are: *Pimephales promelas*, fathead minnow; *Ceriodaphnia dubia*, cladoceran: and *Selenastrum capricornutum*, freshwater algae. If field storm water salinity tests indicate the use of marine species to be more appropriate, the following species will be used in the bioassays: *Menidia beryllina*, inland silversides: *Dendraster excentricus*, the sand dollar; and *Skeletonema costatum*, a marine algae. *Strongylocentrotus purpuratus*, the sea urchin may be substituted for the sand dollar, depending on the time period in which the bioassay tests are conducted. The three selected test species are all commonly used in the San Francisco Bay region for assessment of chronic toxicity.

4.4 COLLECTION AND PREPARATION OF WATER FOR BIOASSAY SYSTEMS AND CHEMICAL ANALYSES

4.4.1 Collection of Composite Storm Water Runoff Samples

Collection of storm water runoff samples will take place as soon as possible within a significant storm event during the rainy season. A significant storm event is defined as an event that would provide sustained runoff for a minimum of 5 hours (HLA, 1991). During HLA's Water Quality Investigation of Stormwater Drainage at HPA, local professional weather forecasters were consulted in order to estimate the number of inches of precipitation that would correlate to the required 5 hours of runoff (HLA, 1991). Storms that produce 0.3 inches of rain were estimated to provide 5 hours of runoff (Somers, 1990). As this criteria proved sucessful during the HLA storm water sampling event at HPA, it will be used to determine if an approaching storm warrants sampling.

A composite sample of storm water will be manually collected over an 8-hour period (at the rate of 10 liters every hour) at each runoff sampling point to provide an indication of the average

quality of the effluent over the sampling period. Field activities will be coordinated so that sample collection will occur simultaneously at each site. It is anticipated that a maximum of eight 10-liter discrete water samples at each sampling point (station) will be collected. Due to the unpredictability of natural storm events, it may not be possible to collect the maximum eight storm water samples. Water samples will be collected from the storm drains using pre-cleaned 4-inch diameter PVC bailers and decanted directly from the bailers into a 10-liter plastic container. Storm water runoff salinity will be measured in the storm drain by refractometer at the time of sample collection. A maximum of eight discrete samples from each sampling station will then be composited into one composite sample per station. The composite sample from each station will be split for chemical analysis and bioassay testing. Sample size and containers are described in Table 2 of the Quality Assurance Project Plan. The composite samples will be chilled to 4° C and stored at this temperature until used for toxicity testing and chemical analysis.

One suite of bioassay tests will be conducted for each composite sample collected. The species selected for use in the chronic bioassays will be those considered most appropriate for salinities encountered in the storm water runoff. Storm water samples will also be submitted for chemical analysis for CLP metals, CLP VOCs, CLP SOCs, CLP pesticides and PCBs, and tributyltin by GC/FID.

The following materials will be needed for collection of composite storm water runoff samples for chemical analysis and for use in the chronic bioassays:

- o 10 liter plastic jugs
- o Pre-cleaned 4-inch diameter PVC bailers
- o Refractometer for storm water runoff salinity measurements
- o 240 ml glass jars with teflon-lined screw caps for collection of storm water samples to be analyzed for VOCs (one composite sample per station)
- o 2 liter glass containers with teflon-lined screw caps for collection of storm water samples to be analyzed for SOCs (one composite sample per station)
- o 480 ml polyethylene jars with teflon-lined screw caps for collection of storm water samples to be analyzed for metals/inorganics (one composite sample per station)
- o 2 liter glass jars with teflon-lined screw caps for collection of storm water samples to be analyzed for pesticides and PCBs (one composite sample per station)
- o 2 liter glass jars with teflon-lined screw caps for collection of storm water samples to be analyzed for tributyltin (one composite sample per station)
- o Ice chests (containing blue ice).

The composite samples will be chilled to 4° C during collection and stored at this temperature until used. The samples will be used within 36 hours of collection. Holding times for various chemical analyses (QAPjP - Table 2) will not be exceeded.

4.4.2 Collection and Preparation of Composite Bay Water Samples

Collection of four composite bay water samples from the proposed bay water sampling points will

require the same materials and preservation methods described in Section 4.4.1. The composite bay water samples will be manually collected over an 8-hour period (at the rate of 10 liters every hour) simultaneous to collection of storm water runoff samples. Prior to being used in the chronic bioassays, the bay water samples will be diluted with deionized water to the same salinity as the storm water runoff samples. One suite of bioassay tests will be conducted for each composite sample collected. Chemical analysis of bay water samples will include CLP metals/inorganics, CLP VOCs, CLP SOCs, CLP pesticides and PCBs, and tributyltin by GC/FID.

4.4.3 Collection and Preparation of Reference Water Sample

Collection of a reference water sample from the proposed reference water sampling point, San Pablo Bay, will require the same materials and preservation described in Section 4.4.1. The reference water sample will be a 10 liter non-composited estuarine water sample collected from the surface at San Pablo Bay. Prior to
being used in the chronic bioassays, the reference water will be diluted with deionized water to the same salinity as the bay samples.

4.4.4 Preparation of Dilution Water

For toxicity tests which are used to determine either the inherent toxicity of an effluent or the toxicity of an effluent in uncontaminated saline receiving water, it is recommended that dilution water be prepared from deionized water and artificial sea salts (EPA, 1988c). The dilution water will be prepared just prior to initiation of the bioassays from deionized water and either artificial sea salts or concentrated Bodega Bay water to the same salinity as the storm water samples. The dilution water will be used for the five dilution series described in Section 4.6.3 and as the control water in the suite of control bioassays.

4.5 LABORATORY SELECTION

The laboratory should be approved by the RWQCB as a bioassay laboratory, for chronic toxicity testing and should have participated in the EPA "Round-Robin" testing program with acceptable results.

4.6 LABORATORY PREPARATION OF BIOASSAY SYSTEMS

4.6.1 Materials

The following materials will be required for preparation of the bioassay systems:

- o Thermometer
- o Salinity meter
- o Hypersaline brine (prepared from deionized water and artificial sea salts)
- o Dissolved oxygen (DO) meter
- o 30 um plankton net
- o Bubble aeration apparatus
- o pH Meter.

4.6.2 Preparation

The following procedures will be employed for preparation of the bioassay systems:

- Tests will be conducted under conditions known to be non-stressful for the test organisms. The temperature and salinity of the test water will approximate the conditions where the organism was collected.
- If necessary, the sample will be adjusted to appropriate salinity with hypersaline brine
- DO of prefiltered sample will be measured and recorded
- Sample water will be filtered with plankton net to remove indigenous organisms
- DO of dilution water will be adjusted to near saturation
- Sample and dilution water will be added to test tanks in the appropriate dilution ratios (See Section 4.6.3)
- pH of test tanks will be measured and recorded.

4.6.3 Dilution Series

A dilution factor of 0.3 will be used to allow testing between 100 percent and 1 percent of the storm water runoff and bay water samples using five concentrations (100%, 30%, 10%, 3%, 1%).

4.7 BIOASSAY PROCEDURES

The species selected for use in the 3-species chronic bioassays will be those considered most appropriate for salinities measured in the storm water runoff. Storm water runoff salinity will be measured in the field at the time of sample collection. If storm water salinities greater than 5 parts per thousand are measured, the estuarine or marine species in the alternate marine biossay procedure section (Section 4.7.2), with a tolerance for salinity will be utilized, as opposed to the freshwater species commonly used for effluent toxicity testing.

4.7.1 Freshwater Bioassay Procedures

4.7.1.1 Fathead Minnow (*Pimephales promelas*) Survival and Growth Test - EPA Method 1000 (EPA, 1989c)

This method will use fathead minnows, less than 36-hours old in a seven-day static renewal test of five storm water runoff dilutions (in geometric series). Toxic effects of chemical, physical, and biological components will be considered by observing adverse effects or physiological and biochemical functions in the test species. Test results will be based on survival and growth (weight increase) of the larvae held in storm water test solutions compared with freshwater control sample larvae.

4.7.1.2 Cladoceran (*Ceriodaphnia dubia*) Survival and Reproduction Test - EPA Method 1002 (EPA, 1989c)

This method will use cladocerans less than 24 hours old, and all within 8 hours of the same age in a seven-day static renewal test of five storm water run-off dilutions (in geometric series). Test

results will be based on survival of the test organisms and reproduction and survival of offspring held in storm water test solutions compared with those held in freshwater control.

4.7.1.3 Algal (*Selenastrum capricornutum*) Growth Test - EPA Method 1003 (EPA, 1989c)

This method will measure chronic toxicity of five dilutions of storm water runoff to freshwater algae during a four day (96 hour) static exposure. Toxic effects of chemical, physical, and biological components will be considered by observing adverse effects of physiological and biochemical functions in the test species. The response of the algal population will be measured in terms of changes in cell density (cell counts per mL) relative to freshwater control water samples.

4.7.2 Alternate Marine Bioassay Procedures

4.7.2.1 Inland Silverside (*Menidia beryllina*) Larval Survival and Growth Test - EPA Method 1006 (EPA, 1988c)

This method will use seven-to-eleven day old inland silverside larvae in a seven-day static renewal test of five storm water runoff dilutions. Toxic effects of chemical, physical, and biological components will be considered by observing adverse effects of physiological and biochemical functions in the test species. Test results will be based on survival and growth (weight increase) of test larvae as compared to bay water, reference, and control sample larvae. This test is recommended as a short term method for estimating chronic toxicity of effluents to estuarine and marine (5 - 32 parts per thousand) species.

4.7.2.2 Sand Dollar (*Dendraster excentricus*) or Sea Urchin (*Strongylocentrotus purpuratus*) Echinoderm Fertilization Success Test - Species Modified EPA Method 1008 (EPA, 1988c)

This rapid-chronic method will measure the toxicity of five storm water runoff dilutions to gametes of the sand dollar during a 1 hour and 20 minute exposure. By exposing dilute sperm suspensions to runoff dilutions for one hour, adding eggs and determining percent fertilization during a 20 minute period, the concentration of a test substance that reduces fertilization of exposed gametes relative to that of the bay water, reference, and control samples will be determined. The test species utilized will depend on the time period in which the bioassays are conducted. *D. excentricus* will be used if the test period falls in April through October; the sea urchin will be used during an October through April test period due to the different spawning periods of the organisms.

4.7.2.3 Algal (*Skeletonema costatum*) Growth Test - Species Modified EPA Method 1003 (EPA, 1985)

This method will measure the chronic toxicity of five dilutions of storm water runoff to marine algae during a four-day (96-hour), static exposure. Toxic effects of chemical, physical, and biological components will be considered by observing adverse effects of physiological and biochemical functions in the test species. The response of the algal population will be measured in terms of changes in cell density (cell counts per mL) relative to the bay water, reference, and control samples.

4.8 PRESENTATION OF DATA

Should survival of control groups be considered acceptable (greater than 90 percent), the results of the chronic bioassays will be presented in tabular form and discussed in the environmental evaluation section of the individual PHEEs. In the event that control mortality is unacceptably

high, species selection and other test variables will be re-evaluated and the test repeated.

4.9 CHEMICAL ANALYSIS CONFIRMATION

Chemical analysis will be conducted on composite storm water runoff samples from each test station and the and bay water sample stations to provide information regarding contaminants in the storm water that, if present and biologically available, could cause toxicity. Collection, preservation, and storage of the water samples used for analysis are described in Section 4.4. The analytical program is presented in Table 3.

The storm water runoff and bay water samples will be analyzed for both inorganic and organic constituents. A list of the analytical methods, analyte list, and approximate quantitation limits are presented in Table 7. The classes of target chemicals for analysis include metals/inorganics, VOCs, SOCs, pesticides and PCBs, and tributyltin. These analyses will be performed in accordance with the procedures outlined in EPA CLP Statements of Work (SOWs) (EPA, 1988a,b).

Water samples will be sent to CLP qualified laboratory(s) immediately following collection for the various chemical analyses. Laboratories utilized for chemical analysis will meet the CLP requirements and standards for equipment, personnel, laboratory practices, analytical operations and quality control operations and follow CLP standard protocol. The laboratory(s) will be certified by the State of California Department of Health Services.

4.10 QUALITY ASSURANCE SUMMARY

Provisions for quality assurance will be made where applicable and specifically in the following areas:

- Test organisms will be disease-free and positively identified to species
- Laboratory and bioassay temperature control equipment will be adequate to maintain required test water temperature
- Instruments used for measurement of water parameters will be calibrated and standardized
- Survival of control groups will be at least 90 percent to be considered acceptable. The algal test will have cell density in controls after 96 hours greater than 10^6 cells/mL to be considered acceptable.

REFERENCES

ALEXANDER, G.V., D.R. Young, Trace metals in Southern California mussels. Mar. Poll.Bull. 7:7-9, 1976.

ASTM, American Society for Testing and Materials, Annual Book of ASTM Standards, Water and Environmental Technology, Vol. 11.04, Philadelphia, PA, pp. 709-731, 1988.

BONILLA, MG.G. Preliminary Geologic Map of the San Francisco South Quadrangle and Part of the Hunters Point Quadrangle, California, United States Geological Survey. Miscellaneous Field Studies Map MF-311, 1:24.000, 1971.

DA, San Francisco District Attorney's Office, People of the State of California v. Triple A Machine Shop, Inc., et al. (1987), Exhibits to People's Memorandum of Points and Authorities in Support of Temporary Restraining Order, Construction Trust, and Appointment of Receiver filed by Arlo Smith, District Attorney, et al. in the Superior Court of the State of California in and for the City and County of San Francisco, 1987.

DURELL, G.S., and A.D. Uhler, Measurement of Butyltin Species in Tissues by n-Pentyl Derivatization with Gas Chromatography/Flame Photometric Detection and Optional Confirmation by Gas Chromatography/Mass Spectrometry, Battelle Ocean Sciences, Duxbury, MA., Laboratory Project Number N-0519-6300, February 22, 1989.

EMCOM, Verification Step Plan of Action, Hunters Point Naval Shipyard (Disestablished), San Francisco, California, 1987.

EPA, Environmental Protection Agency, Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, W.B. Horning, III, C.I.Weber, eds., Environmental Monitoring and Support Laboratory - Cincinnati, Office of Research and Development, EPA/600/4-85/014, 1985.

EPA, Environmental Protection Agency, Test Methods for Evaluating Solid Waste, Vol I: Laboratory Manual Physical/Chemical Methods, Third Edition, Office of Solid Waste and Emergency Response, Washington, D.C., SW-846, November, 1986.

EPA, Environmental Protection Agency USEPA Contract Laboratory Program, Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration, SOW No. 788, 1988a.

EPA, Environmental Protection Agency USEPA Contract Laboratory Program, Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration, February, 1988b.

EPA, Environmental Protection Agency, Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms, C.I. Weber, W.B. Horning, et al, eds., Environmental Monitoring and Support Laboratory - Cincinnati, Office of Research and Development, EPA/600/4-87/028, 1988c.

EPA, Environmental Protection Agency, Risk Assessment Guidance for Superfund: Environmental Evaluation Manual, Interim Final, Office of Emergency and Remedial Response, Washington, D.C., EPA/540/1/89/001A, March, 1989a.

EPA, Environmental Protection Agency, Ecological Assessments of Hazardous Waste Sites: A Field and Laboratory Reference Document, Washington, D.C., EPA/600/3-89/013, March 1989b.

EPA, Environmental Protection Agency, Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, C.I. Weber, W.B. Horning, et al, eds., Environmental Monitoring and Support Laboratory - Cincinnati, Office of Research and Development, EPA/600/4-89/001,1989c.

EPA/COE, Environmental Protection Agency/Corps of Engineers, Evaluation of Dredged Material Proposed for Ocean Disposal - Testing Manual, Implementation Manual for Section 103 of Public Law 92-532 (Marine Protection, Research, and Sanctuaries Act of 1972), EPA 503/8-91/001, February, 1991.

ERM-West, Fence to Fence Hazardous Materials Survey, Naval Station, Treasure Island, Hunters Point Annex, San Francisco, California, July, 1988.

ESA, Environmental Science Associates, EIS: Homeporting Battleship Battlegroup/Cruiser Destroyer Group, Vol. III: Verification Testing of Dredge Sediments, Prepared for U.S. Department of the Navy, Western Division, Naval Facilities Engineering Command, San Francisco, California, June, 1987.

FDA, U.S. Food and Drug Administration, Pesticide Analytical Manual. Vol I., Sec. 211.13f, Food and Feeds, Department of Health, Education and Welfare, 1970.

GORDON, R.M., G.A. Knauer, J.H. Martin, Intertidal Study of the Southern California Bight. Manuscripts originating from the Moss Landing Marine Laboratories, 1978.

HLA, Harding Lawson Associates, Workplan Volume 2A, Sampling Plan for Group I Sites, Remedial Investigation/Feasibility Study, Naval Station, Treasure Island, Hunters Point Annex, San Francisco, California, December, 1988a.

HLA, Harding Lawson Associates, Workplan Volume 2B, Sampling Plan for Group II Sites, Remedial Investigation/Feasibility Study, Naval Station, Treasure Island, Hunters Point Annex, San Francisco, California, November, 1988b.

HLA, Harding Lawson Associates, Workplan Volume 2C, Sampling Plan for Group III Sites, Remedial Investigation/Feasibility Study, Naval Station, Treasure Island, Hunters Point Annex, San Francisco, California, December, 1988c.

HLA, Harding Lawson Associates, Workplan Volume 2D, Sampling Plan for Group IV Site, Remedial Investigation/Feasibility Study, Naval Station, Treasure Island, Hunters Point Annex, San Francisco, California, December 1988d.

HLA, Harding Lawson Associates, Preliminary Assessment, Sites PA-12 through PA-18, Naval Station, Treasure Island, Hunters Point Annex, San Francisco, California, November 16, 1989.

HLA, Harding Lawson Associates, Work Plan Volume 2F, Sampling Plan for Group V, Remedial Investigation/Feasibility Study, Naval Station, Treasure Island, Hunters Point Annex, San Francisco, California, December, 1990a.

HLA, Harding Lawson Associates, Reconnaissance Activities Report, Remedial Investigation/Feasibility Studies, Naval Station, Treasure Island, Hunters Point Annex, San Francisco, California, August 9, 1990b.

HLA, Harding Lawson Associates, Site Inspection Work Plan, Sites PA-16 and PA-18, Naval Station, Treasure Island, Hunters Point Annex, San Francisco, California, March 14, 1990c.

HLA, Harding Lawson Associates, Preliminary Assessment Other Areas/Utilities, Naval Station, Treasure Island, Hunters Point Annex, San Francisco, California, October 19, 1990d.

HLA, Harding Lawson Associates, Draft Water Quality Investigations of Stormwater Drainage, Naval Station, Treasure Island, Hunters Point Annex, July 10, 1991.

LOWNEY/KALDVEER Associates, Foundation Investigation, Water Pollution Abatement Facilities, Hunters Point Naval Shipyard, 1972.

MATTHIAS, C.L., Bellama, J.M. Brinkman, F.E. Proceedings of the organotin symposium. In: Oceans'86 Conference R.L., Swanson (ed). IEEE Service Center, Piscataway, NJ, 1986a.

MATTHIAS, C.L., Bellama, J.M., Olson, G.J., Brinkman, F.E., Comprehensive method for determination of aquatic butyltin and butylmethyltin at ultratrace levels using simultaneous hybridization/extraction with GC/FPD detection. Environ. Sci. Technol. 20:609-615, 1986b.

NOAA, National Oceanic and Atmospheric Administration, Status and Trends in Concentrations of Contaminants and Measures of Biological Stress in San Francisco Bay Seattle, Washington, May, 1988.

OUELLETTE, T., Seasonal variation of trace metals and the major inorganic ions in the mussel, *Mytilus californiaus*. Master's thesis, Calif. State Univ., Hayward, 90 pp., 1978.

PRC Environmental Management, Inc., Removal Action Plan/Closure Plan, The Naval Station Treasure Island, Hunters Point Annex, San Francisco, California, May 29, 1990.

SOMERS, T., Personal Communication between B. King, HLA, and Tim Somers, KGO Weather Service, November, 1990.

SNEDECOR, G.W., and G.C. Cochran, Statistical Methods, Iowa State University Press, Ames, Iowa, 507 pp., 7th Edition, 1980.

STAINTON, M. Syringe procedure for transfer of nanogram quantities of mercury vapor for flameless atomic absorption spectrophotometry. Anal. Chem. 43(4):625-627,1971.

STEPHENSON, M.D., D. Smith, G. Ichikawa, J.Goetzl, W. Laurendine, M. Martin, State Mussel Watch Program Preliminary Data Report 1986-1987., Calif. Dept. Fish & Game Report, Monterey, California, 1987.

SWRCB, State Water Resources Control Board, California State Mussel Watch 1983-1984., Water Quality Monitoring Report No. 85-2WQ, 1985.

SWRCB, State Water Resources Control Board, California State Mussel Watch 1986-1987., Water Quality Monitoring Report No. 88-3, 1988.

UHLER, A.D., and G.S. Durell, Measurement of Butyltin Species in Sediments by n-Pentyl Derivatization with Gas Chromatography/Flame Photometric Detection and Optional Confirmation by Gas Chromatography/Mass Spectrometry, Battelle Ocean Sciences, Duxbury, MA., Laboratory Project Number N-0519-6100, February 28, 1989.

WESTEC Services, Inc., Initial Assessment Study, Hunters Point Naval Shipyard (Disestablished), San Francisco, California, Contract No. N62474-83-C-6972, October, 1984.

GLOSSARY

ANOVA	Analysis of variance
ATSM	American Society for Testing and Materials
ATT	Aqua Terra Technologies, Incorporated
CDFG	California Department of Fish and Game
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
DHS	California Department of Health Services
DO	Dissolved Oxygen
ECD	Electron Capture Detection
EIS	Environment Impact Statement
EPA	U.S. Environmental Protection Agency
EPA/COE	U.S. Environmental Protection Agency/Corps of Engineers
ESAP	Environmental Sampling and Analysis Plan
FDA	U.S. Food and Drug Administration
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrocopy
HLA	Harding Lawson Associates
HPA	Hunters Point Annex
IAS	Initial Assessment Study
ICP	Inductively Coupled Plasma Spectroscopy
IR	Installation Restoration
MSL	Mean Sea Level
NACIP	Navy Assessment and Control of Installation Pollutants
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NOAA	National Oceanic and Atmospheric Administration

NPDES	National Pollutant Discharge Elimination System
O&G	Oil and Grease
PA	Preliminary Assessment
PCBs	Polychlorinated biphenyls
PHEE	Public Health and Environmental Evaluation
QA/QC	Quality Assurance/Quality Control
RI/FS	Remedial Investigation/Feasibility Study
RWQCB	Regional Water Quality Control Board
SARA	Superfund Amendments and Reauthorization Act
SMW	State Mussel Watch
SOCs	Semi-volatile Organic Compounds
SWRCB	State Water Resources Control Board
VOCs	Volatile Organic Compounds

ATT

Table 1. IR/PA Sites By Group*

Group	Site	Site Description	Known or Potential Site Contamination
Group I	IR-1	Industrial Landfill and Triple A Sites 1 and 16[a]	Liquid chemical wastes, asbestos, radium dials, and sand blast wastes with paint scrapings (1958-1974)
	IR-2	Bay Fill Area and Triple A Sites 2, 13, 14, 17, 18, and 19; excluding IR-3	Sand blast waste with heavy metals, chemicals, and waste oil (mid 1940s-1978)
	IR-3	Oil Reclamation Ponds and part of Triple A Site 17	Waste oil, solvents, caustic soda, chromates, and sand blast waste (1944-1974)
Group II	IR-6	Tank Farm	Diesel fuels and oils (1942-present)
	IR-8	Building 503 PCB Spill Area	PCBs
	IR-9	Pickling and Plate Yard	Zinc chromate and acids (1947-1973)
	IR-10	Battery and Electroplating Shop (Building 123)	Waste acids, heavy metals, cyanide wastes, and chromates (1946-1974)
Group III	IR-4	Scrap Yard and Triple A Site 3, north of Spear Avenue	Heavy metals and PCBs (1954-1974)
	IR-5	Old Transformer Storage Yard	PCBs (1946-1947)
Group IV	IR-7	Sub-base Area	Zinc chromate paint, diesel fuel, and sand blast waste
Group V	IR-11	Building 521 Power Plant	Asbestos (1950-1969)
	IR-12	Disposal Trench, Triple A Sites 3 (partial) and 4 (previously Site PA-12)	Metals, chemicals, and low levels of PCBs and asbestos (1976-1986)
	IR-13	Old Commissary Site, Triple A Sites 5 and 15 (previously Site PA-13)	Metals, low-levels of PCBs and chemicals, and unidentified hydrocarbons (1976-1986)
	IR-14	Oily Liquid Waste Disposal Site, Triple A Sites 6 and 7 (previously Site PA-14)	Chemicals, and possibly PCBs (1976-1986)

ATT

Table 1. IR/PA Sites by Group* (continued)

Group	Site	Site Description	Known or Potential Site Contamination
	IR-15	Oily Waste Ponds and Incineration Tank, Triple A Sites 12 and 13 (partial) (previously Site PA-15)	Metals, low-levels of chemicals, and possibly PCBs (1976-1986)
	IR-17	Drum Storage and Disposal Site, Triple A Sites 10 and 11 (previously Site PA-17)	Low-levels of PCBs (1976-1986)
NA[b]	PA-16	Container Storage Site, Triple A Site 9	PCBs and other substances based on reported history of Triple A disposal practices (1976-1986)
NA	PA-18	Waste Oil Disposal Site behind Dago Mary's, Unnumbered Triple A Site	Total petroleum hydrocarbons based on reported history of Triple A disposal practices and limited analytical data (1976-1986)

* Information for this table was taken from "The Navy's Environmental Cleanup of Hunters Point" Fact Sheet and the Site Inspection Work Plan, Sites PA-16 and PA-18, Naval Station, Treasure Island, Hunters Point Annex, San Francisco, California (HLA, 1990b)

a This numbering system was previously used by the San Francisco District Attorney's Office and the U.S. Navy. These areas/sites have been included within IR and PA Sites

b NA: Not Applicable. Recommendations for inclusion of these sites in the Installation Restoration program will be based upon the results of the site inspections described in the work plan

Table 2. Summary of Underground Storage Tanks

Tank Number	Tank Contents	Status
S-001, S-002 S-003, S-004	Gasoline Diesel	BTX identified in soil gas vapors TCA, DCE, DCA, and TCE identified in vicinity of tanks
S-203 (212)	Gasoline	BTX identified in soil gas samples TCA, DCE, DCA, and TCE identified in vicinity of tank
S-209	Fuel Oil Water (if present)	Product on the groundwater surface PCE identified in tank contents
S-210 (213)	Water	PCB, toluene, ethylbenzene, and xylenes identified in tank contents No soil contamination by hydrocarbons identified
S-214	Fuel Oil Water	Soil contamination by hydrocarbons confirmed
S-215	Solvent	Xylenes identified in soil gas samples
S-251	Solvent	Xylenes identified in soil gas samples TCA, DCE, DCA, and TCE identified in vicinity of tank
S-304, S-305	Gasoline	BTX identified in soil gas samples TCA, DCE, DCA, and TCE identified in vicinity of tank
S-435(1), S-435(2)	Solvent with Gasoline	BTX identified in soil gas samples TCA, DCE, DCA, and TCE identified in vicinity of tank
S-508	Fuel Oil	Hydrocarbons and acetone identified in soil Acetone identified in tank contents
S-711, S-712 S-713	Gasoline	BTX identified in soil gas samples
S-714	Diesel	BTX identified in soil gas samples
S-715	Waste Oil and Water	Xylene and toluene identified in soil gas samples TCA, DCE, DCA, and TCE identified in vicinity of tank

Table 2. Summary of Underground Storage Tanks (continued)

Tank Number	Tank Contents	Status
S-801	Gasoline and Solvent	Petroleum hydrocarbons identified in soil
S-802	Gasoline	Petroleum hydrocarbons identified in soil
S-812	Fuel Oil	Soil contamination not indicated

BTX = Benzene, Toluene, Xylene
TCA = Trichloroethane
DCE = Dichloroethylene
DCA = Dichloroethane
TCE = Trichlorethylene
PCE = Tetrachloroethylene

Source: PRC, 1990

Table 3. Sampling and Analytical Program

Evaluation Program and Sample Location Numbers	Number of Samples[a]	Media Type[b]	Radio-Activity Screen	Toxicity Testing	Physical Testing[c]	Radio-Activity Testing[d]	Total Organic Carbon	In-organics/ Metals	Pesti-cides/ PCBs	Semi-Volatile Organics	Tribu-tyltin[e]	Volatile Organics
Sediment Toxicity												
S-1 to S-17	17	S	X	X[f]	X	X	X	X	X	X	X	--
Reference	3	S	X	X[f]	X	X	X	X	X	X	X	--
Control	1	S	X	X[f]	X	--	--	--	--	--	--	--
Sediment Cores	19	S	X	--	X	X	X	X	X	X	X	X
Bioaccumul -ative Effect												
M-1 to M-17	17	T	X	--	--	X	--	X	X	X	X	--
Background	1	T	X	--	--	--	--	X	X	X	X	--
Reference	2	T	X	--	--	--	--	X	X	X	X	--
Storm Water Toxicity												
ST1 to ST4	4	SW	--	X[g]	--	--	--	X	X	X	X	X
B-1 to B-4	4	BW	--	X[g]	--	--	--	X	X	X	X	X
Reference	1	BW	--	X[g]	--	--	--	--	--	--	--	--

a These numbers describe composited samples. The samples will be sub-sampled for screening of radioactivity, toxicity testing, physical testing, chemical analyses, or field and laboratory Quality Control (QC) samples
b Media Type: S = sediment, T = tissue, SW = storm water, BW = bay water
c Physical testing includes determination of grain size by ASTM Method D422
d Laboratory testing of radioactivity will be conducted on samples exhibiting radioactivity above background levels as determined by radioactivity screening. Radioactivity screening will include measurement of alpha and beta particles and gamma rays
e Analytical method: n-Pentyl Derivitization with Gas Chromatography/Flame Photometric Detection
f Toxicity testing of sediment samples involves the use of five replicates in 10-day solid phase bioassays and liquid suspended particulate phase bioassays
g Toxicity testing of storm and bay water samples involves a five dilution series

Table 4. List of Selected Test Species

Task Number	Test Description	Type of Organism	Common Name	Scientific Name
1	Modified Solid-Phase Bioassay	Burrowing Infaunal Polychaete	Marine Worm	*Nephtys caecoides*
		Deposit-feeding Crustacean	Mysid Shrimp	*Holmesimysis costata*
	Amphipod Sediment Bioassay	Filter or Deposit-feeding Crustacean	Amphipod	*Eohaustorius estuarius*
	Liquid Suspended Particulate-Phase Bioassay	Filter or Deposit-feeding Bivalve	Oyster or Bay Mussel	*Crassostrea gigas* or *Mytilus edulis*
		Deposit-feeding Crustacean	Mysid Shrimp	*Holmesimysis costata*
		Fish	Sand Dab	*Citharichthys stigmaes*
2	Bioaccumulation	Bivalve	California Mussel	*Mytilus californianus*
3	Larval Survival and Growth	Fish	Fathead Minnow[a] or Inland Silverside[b]	*Pimephales promelas*[a] *or Menidia Beryllina*[b]
	Fertilization Success	Crustacean or Echinoderm	Water Flea[a] or Sand Dollar/Sea Urchin[b]	*Ceriodaphnia dubia*[a] or *Strongylocentrotus purpuratus* or *Dendraster excentricus*[b]
	Growth Test	Algae	Freshwater Algae[a] or Marine Algae[b]	*Selenastrum capricornutum*[a] or *Skeletonema castatum*[b]

a. Freshwater species to be used in bioassay if storm water is non-saline.
b. Marine species to be used in bioassay if storm water is saline.

Table 5. Analytical Methods for Sediment Analyses

Sample Numbers	Sample Matrix	Analytical Method	Analytical Constituents	Approximate Quantitation Limits
S-1 - S-17	Sediment	CLP Inorganics (mg/Kg)	Aluminum	10.0
			Antimony	1.0
			Arsenic	0.5
			Barium	10.0
			Beryllium	0.25
			Cadmium	0.25
			Calcium	250.0
			Chromium (total)	0.5
			Cobalt	0.5
			Copper	0.5
			Iron	5.0
			Lead (total)	0.15
			Magnesium	250.0
			Manganese	0.75
			Mercury	0.01
			Molybdenum	0.50
			Nickel	2.0
			Potassium	250.0
			Selenium	0.25
			Silver	0.5
			Sodium	250.0
			Thallium	0.5
			Tin	0.25
			Vanadium	2.5
			Zinc	1.0
		CLP Pesticides/PCBs (μg/Kg)	alpha-BHC	0.5
			beta-BHC	0.5
			gamma-BHC (Lindane)	0.5
			delta-BHC	0.5
			Heptachlor	0.5
			Aldrin	0.5
			Heptachlor epoxide	0.5

Table 5. Analytical Methods for Sediment Analyses

Sample Numbers	Sample Matrix	Analytical Method	Analytical Constituents	Approximate Quantitation Limits
			Endosulfan I	0.5
			p,p'-DDE	0.5
			Dieldrin	0.5
			Endrin	0.5
			p,p'-DDD	0.5
			Endosulfan II	0.5
			p,p'-DDT	0.5
			Endrin aldehyde	0.5
			Endosulfan sulfate	0.5
			p,p'-Methoxychlor	1.0
			Endrin ketone	2.5
			Technical chlordane	5.0
			Toxaphene	10
			Aroclor 1016	2.0
			Aroclor 1221	2.0
			Aroclor 1232	2.0
			Aroclor 1242	2.0
			Aroclor 1248	2.0
			Aroclor 1254	2.0
			Aroclor 1260	2.0
		CLP SOCs (μg/Kg)	Phenol	330
			bis(2-Chloroethyl) Ether	330
			2-Chlorophenol	330
			1,3-Dichlorobenzene	330
			1,4-Dichlorobenzene	330
			Benzyl Alcohol	330
			1,2-Dichlorobenzene	330
			2-Methylphenol	330
			bis(2-Chloroisopropyl) Ether	330
			4-Methylphenol	330

Table 5. Analytical Methods for Sediment Analyses

Sample Numbers	Sample Matrix	Analytical Method	Analytical Constituents	Approximate Quantitation Limits
			N-Nitroso-di-n-Propylamine	330
			Hexachloroethane	330
			Nitrobenzene	330
			Isophorone	330
			2-Nitrophenol	330
			2,4-Dimethylphenol	330
			Benzoic Acid	1600
			bis(2-Chloroethoxy)Methane	330
			2,4-Dichlorophenol	330
			1,2,4-Trichlorobenzene	330
			Naphthalene	330
			4-Chloroaniline	330
			Hexachlorobutadiene	330
			4-Chloro-3-Methylphenol	330
			2-Methylnaphthalene	330
			Hexachlorocyclopentadiene	330
			2,4,6-Trichlorophenol	330
			2,4,5-Trichlorophenol	1600
			2-Chloronaphthalene	330
			2-Nitroaniline	1600
			Dimethylphthalate	330
			Acenaphthylene	330
			3-Nitroaniline	1600
			Acenaphthene	330
			2,4-Dinitrophenol	1600
			4-Nitrophenol	1600
			Dibenzofuran	330
			2,4-Dinitrotoluene	330
			2,6-Dinitrotoluene	330
			Diethylphthalate	330

Table 5. Analytical Methods for Sediment Analyses

Sample Numbers	Sample Matrix	Analytical Method	Analytical Constituents	Approximate Quantitation Limits
			4-Chlorophenyl-Phenyl Ether	330
			Fluorene	330
			4-Nitroaniline	1600
			4,6-Dinitro-2-Methylphenol	330
			N-Nitrosodiphenylamine	330
			Azobenzene	330
			4-Bromophenyl-Phenyl Ether	330
			Hexachlorobenzene	330
			Pentachlorophenol	1600
			Phenanthrene	330
			Anthracene	330
			Di-n-Butylphthalate	330
			Fluoranthene	330
			Benzidine	1600
			Pyrene	330
			Butylbenzylphthalate	330
			3,3'-Dichlorobenzidine	660
			Benzo(a)Anthracene	330
			bis(2-Ethylhexl)phthalate	330
			Chrysene	330
			Di-n-Octylphthalate	330
			Benzo(b)Fluoranthene	330
			Benzo(k)Fluoranthene	330
			Benzo(a)Pyrene	330
			Indeno(1,2,3-cd)Pyrene	330
			Dibenz(a,h)Anthracene	330
			Benzo(g,h,i)Perylene	330

Table 5. Analytical Methods for Sediment Analyses

Sample Numbers	Sample Matrix	Analytical Method	Analytical Constituents	Approximate Quantitation Limits
		GC/FPD[a] with n-pentyl-derivization (μg/Kg)	Tributyltin	10
		Radiation: (pCi/gm)[b]		
		EPA Method 9310	Alpha	2
		EPA Method 9310	Beta	4
		Spectroscopy	Gamma	0.5
	Sediment[c]	CLP VOCs (μg/Kg)	Chloromethane	10
			Vinyl Chloride	10
			Bromomethane	10
			Chloroethane	10
			Trichlorofluoromethane	5
			1,1-Dichloroethene	5
			Trichlorotrifluoroethane	5
			Acetone	20
			Carbondisulfade	5
			Methylene Chloride	5
			trans-1,2-Dichloroethene	5
			1,1-Dichloroethane	5
			2-Butanone	20
			cis-1,2-Dichloroethene	5
			Chloroform	5
			1,1,1-Trichloroethane	5
			Carbon Tetrachloride	5
			Benzene	5
			1,2-Dichloroethane	5
			Trichloroethene	5
			1,2-Dichloropropane	5
			Bromodichloromethane	5
			2-Chloroethylvinyl Ether	5
			Vinyl Acetate	10
			trans-1,3-Dichloropropene	5
			4-Methyl-2-Pentanone	10

Sample Numbers	Sample Matrix	Analytical Method	Analytical Constituents	Approximate Quantitation Limits
			Toluene	5
			cis-1,3-Dichloropropene	5
			1,1,2-Trichloroethane	5
			Tetrachloroethene	5
			2-Hexanone	10
			Dibromochloromethane	5
			Chlorobenzene	5
			Ethylbenzene	5
			Total Xylenes	5
			Styrene	5
			Bromoform	5
			1,1,2,2-Tetrachloroethane	5
			1,3-Dichlorobenzene	5
			1,4-Dichlorobenzene	5
			1,2-Dichlorobenzene	5
		Physical Analysis:		
		ASTM Method D422	Grain Size	NA
		EPA Method 9060	Total Organic Carbon	NA

a. Gas chromatography/flame photometric detection
b. pCi/gm = picocuries/gram
c. Analysis for VOCs will be performed on sediment core samples only.
NA - Not Applicable

Table 6. Analytical Methods for Mussel Tissue Analyses

Sample Numbers	Sample Matrix	Analytical Method	Analytical Constituents	Level of Detection (µg/Kg)
M-1 - M-17	Mussel Tissue	Metals - 6010/ICP[a]	Aluminum	200
			Antimony	60
		7060/AA[b]	Arsenic	40
			Barium	100
			Beryllium	10
			Cadmium	10
			Calcium	1000
			Chromium (total)	10
			Cobalt	50
			Copper	25
			Iron	100
		7421/AA[b]	Lead (total)	40
			Magnesium	1000
			Manganese	15
			Molybdenum	10
			Nickel	40
			Potassium	1000
		7740/AA[b]	Selenium	40
			Silver	10
			Sodium	1000
		7841/AA[b]	Thallium	80
			Tin	40
			Vanadium	50
			Zinc	20
		7471/Cold Vapor AA[b]	Mercury	10
		Pest/PCBs - 8080/GC[c]	alpha-BHC	5.0
			beta-BHC	5.0
			gamma-BHC (Lindane)	5.0
			delta-BHC	5.0
			Heptachlor	5.0

Table 6. Analytical Methods for Mussel Tissue Analyses

Sample Numbers	Sample Matrix	Analytical Method	Analytical Constituents	Level of Detection (µg/Kg)
			Aldrin	5.0
			Heptachlor epoxide	5.0
			Endosulfan I	10.0
			p,p'-DDE	5.0
			Dieldrin	2.0
			Endrin	2.0
			p,p'-DDD	5.0
			Endosulfan II	2.0
			p,p'-DDT	5.0
			Endrin aldehyde	5.0
			Endosulfan sulfate	25.0
			p,p'-Methoxychlor	5.0
			Endrin ketone	5.0
			Technical chlordane	25.0
			Toxaphene	30.0
			Aroclor 1016	20.0
			Aroclor 1221	20.0
			Aroclor 1232	20.0
			Aroclor 1242	20.0
			Aroclor 1248	20.0
			Aroclor 1254	20.0
			Aroclor 1260	20.0
		SOCs - 8270/GC/MS[d]	Phenol	160.0
			bis(2-Chloroethyl) Ether	160.0
			2-Chlorophenol	160.0
			1,3-Dichlorobenzene	160.0
			1,4-Dichlorobenzene	160.0
			Benzyl Alcohol	160.0
			1,2-Dichlorobenzene	160.0
			2-Methylphenol	160.0
			bis(2-Chloroisopropyl) Ether	160.0
			4-Methylphenol	160.0

Table 6. Analytical Methods for Mussel Tissue Analyses

Sample Numbers	Sample Matrix	Analytical Method	Analytical Constituents	Level of Detection (µg/Kg)
			N-Nitroso-di-n-Propylamine	160.0
			Hexachloroethane	160.0
			Nitrobenzene	160.0
			Isophorone	160.0
			2-Nitrophenol	160.0
			2,4-Dimethylphenol	160.0
			Benzoic Acid	800.0
			bis (2-Chloroethoxy) Methane	160.0
			2,4-Dichlorophenol	160.0
			1,2,4-Trichlorobenzene	160.0
			Naphthalene	160.0
			4-Chloroaniline	160.0
			Hexachlorobutadiene	160.0
			2,4,6-Trichlorophenol	160.0
			2,4,5-Trichlorophenol	800.0
			2-Chloronaphthalene	160.0
			2-Nitroaniline	800.0
			Dimethylphthalate	160.0
			Acenaphthylene	160.0
			3-Nitroaniline	800.0
			Acenaphthene	160.0
			2,4-Dinitrophenol	800.0
			4-Nitrophenol	800.0
			Dibenzofuran	160.0
			2,4-Dinitrotoluene	160.0
			2,6-Dinitrotoluene	160.0
			Diethylphthalate	160.0
			4-Chlorophenyl-Phenyl Ether	160.0
			Fluorene	160.0
			4-Nitroaniline	800.0
			4,6-Dinitro-2-Methylphenol	800.0
			N-Nitrosodiphenylamine	160.0

Table 6. Analytical Methods for Mussel Tissue Analyses

Sample Numbers	Sample Matrix	Analytical Method	Analytical Constituents	Level of Detection (µg/Kg)
			Azobenzene	160.0
			4-Bromophenyl-Phenyl Ether	160.0
			Hexachlorobenzene	160.0
			Pentachlorophenol	800.0
			Phenanthrene	160.0
			Anthracene	160.0
			Di-n-Butylphthalate	160.0
			Fluoranthene	160.0
			Benzidine	800.0
			Pyrene	160.0
			Butylbenzylphthalate	160.0
			3,3'-Dichlorobenzidine	320.0
			Benzo(a)Anthracene	160.0
			bis(2-Ethylhexl)phthalate	160.0
			Chrysene	160.0
			Di-n-Octylphthalate	160.0
			Benzo(b)Fluoranthene	160.0
			Benzo(k)Fluoranthene	160.0
			Benzo(a)Pyrene	160.0
			Indeno(1,2,3,-cd)Pyrene	160.0
			Dibenz(a,h)Anthracene	160.0
			Benzo(g,h,i)Perylene	160.0
		GC/FPD[e] with a n-pentyl-derivitizaton	Tributyltin	100
		Radiation EPA Method 9310	Alpha	4[f]
		EPA Method 9310	Beta	2[f]
		Spectroscopy	Gamma	0.5[f]

a. ICP; Inductively Coupled Plasma Spectroscopy; all metals will be analyzed by Method 6010/ICP except as noted
b. AA; Atomic Absorption
c. GC; Gas Chromatography
d. GC/MS; Gas Chromatography/Mass Spectroscopy
e. GC/FPD; Gas Chromatography/Flame Photometric Detection
f. Radiation units are picocuries/gram (pCi/gm)

Table 7. Analytical Methods for Storm Water Analyses

Sample Numbers	Sample Matrix	Analytical Method	Analytical Constituents	Approximate Quantitation Limits (µg/L)
ST-1 - ST-4 B-1 - B-4	Water	CLP Inorganics	Aluminum	200.0
			Antimony	3.0
			Arsenic	10
			Barium	100.0
			Beryllium	5.0
			Cadmium	5.0
			Calcium	1000
			Chromium (total)	10.0
			Cobalt	50.0
			Copper	25
			Iron	100
			Lead (total)	3.0
			Magnesium	1000
			Manganese	15.0
			Mercury	0.5
			Molybdenum	10.0
			Nickel	40.0
			Potassium	1000
			Selenium	5.0
			Silver	10.0
			Sodium	1000
			Thallium	10.0
			Tin	40.0
			Vanadium	50.0
			Zinc	20.0
		CLP Pesticides/PCBs	alpha-BHC	0.05
			beta-BHC	0.05
			gamma-BHC (Lindane)	0.05
			delta-BHC	0.05
			Heptachlor	0.05
			Aldrin	0.05

Table 7. Analytical Methods for Storm Water Analyses

Sample Numbers	Sample Matrix	Analytical Method	Analytical Constituents	Approximate Quantitation Limits (µg/L)
			Heptachlor epoxide	0.05
			Endosulfan I	0.1
			p,p'-DDE	0.1
			Dieldrin	0.1
			Endrin	0.1
			p,p'-DDD	0.1
			Endosulfan II	0.1
			p,p'-DDT	0.1
			Endrin aldehyde	0.1
			Endosulfan sulfate	0.1
			p,p'-Methoxychlor	0.5
			Endrin ketone	0.1
			Technical chlordane	0.5
			Toxaphene	1.0
			Aroclor 1016	0.5
			Aroclor 1221	0.5
			Aroclor 1232	0.5
			Aroclor 1242	0.5
			Aroclor 1248	0.5
			Aroclor 1254	1.0
			Aroclor 1260	1.0
		CLP SOCs	Phenol	10
			bis(2-Chloroethyl) Ether	10
			2-Chlorophenol	10
			1,3-Dichlorobenzene	10
			1,4-Dichlorobenzene	10
			Benzyl Alcohol	10
			1,2-Dichlorobenzene	10
			2-Methylphenol	10
			bis(2-Chloroisopropyl) Ether	10
			4-Methylphenol	10

Table 7. Analytical Methods for Storm Water Analyses

Sample Numbers	Sample Matrix	Analytical Method	Analytical Constituents	Approximate Quantitation Limits (µg/L)
			N-Nitroso-di-n-Propylamine	10
			Hexachloroethane	10
			Nitrobenzene	10
			Isophorone	10
			2-Nitrophenol	10
			2,4-Dimethylphenol	10
			Benzoic Acid	50
			bis(2-Chloroethoxy)Methane	10
			2,4-Dichlorophenol	10
			1,2,4-Trichlorobenzene	10
			Naphthalene	10
			4-Chloroaniline	10
			Hexachlorobutadiene	10
			4-Chloro-3-Methylphenol	10
			2-Methylnaphthalene	10
			Hexachlorocyclopentadiene	10
			2,4,6-Trichlorophenol	10
			2,4,5-Trichlorophenol	50
			2-Chloronaphthalene	10
			2-Nitroaniline	50
			Dimethylphthalate	10
			Acenaphthylene	10
			3-Nitroaniline	50
			Acenaphthene	10
			2,4-Dinitrophenol	50
			4-Nitrophenol	50
			Dibenzofuran	10
			2,4-Dinitrotoluene	10
			2,6-Dinitrotoluene	10
			Diethylphthalate	10

Table 7. Analytical Methods for Storm Water Analyses

Sample Numbers	Sample Matrix	Analytical Method	Analytical Constituents	Approximate Quantitation Limits (µg/L)
			4-Chlorophenyl-Phenyl Ether	10
			Fluorene	10
			4-Nitroaniline	50
			4,6-Dinitro-2-Methylphenol	10
			N-Nitrosodiphenylamine	10
			Azobenzene	10
			4-Bromophenyl-Phenyl Ether	10
			Hexachlorobenzene	10
			Pentachlorophenol	50
			Phenanthrene	10
			Anthracene	10
			Di-n-Butylphthalate	10
			Fluoranthene	10
			Benzidine	50
			Pyrene	10
			Butylbenzylphthalate	10
			3,3'-Dichlorobenzidine	20
			Benzo(a)Anthracene	10
			bis(2-Ethylhexl)phthalate	10
			Chrysene	10
			Di-n-Octylphthalate	10
			Benzo(b)Fluoranthene	10
			Benzo(k)Fluoranthene	10
			Benzo(a)Pyrene	10
			Indeno(1,2,3-cd)Pyrene	10
			Dibenz(a,h)Anthracene	10
			Benzo(g,h,i)Perylene	10
		GC/FPD[a] with n-pentyl-derivitization	Tributyltin	10

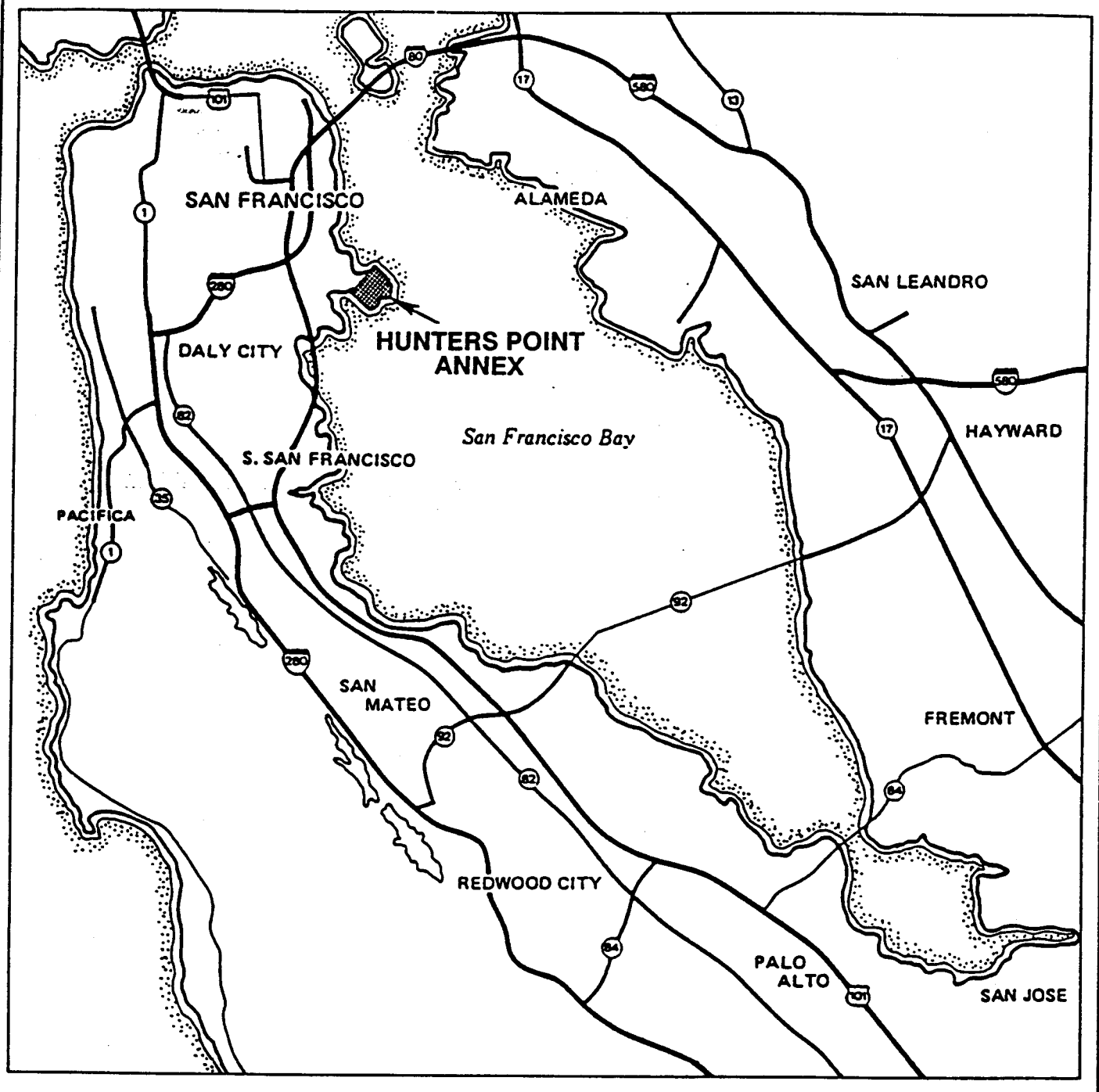
Table 7. Analytical Methods for Storm Water Analyses

Sample Numbers	Sample Matrix	Analytical Method	Analytical Constituents	Approximate Quantitation Limits (µg/L)
ST1-ST4	Water	CLP VOCs	Chloromethane	10
			Vinyl Chloride	10
			Bromomethane	10
			Chloroethane	10
			Trichlorofluoromethane	5
			1,1-Dichloroethene	5
			Trichlorotrifluoroethane	5
			Acetone	20
			Carbondisulfide	5
			Methylene Chloride	5
			trans-1,2-Dichloroethene	5
			1,1-Dichloroethane	5
			2-Butanone	20
			cis-1,2-Dichloroethene	5
			Chloroform	5
			1,1,1-Trichloroethane	5
			Carbon Tetrachloride	5
			Benzene	5
			1,2-Dichloroethane	5
			Trichloroethene	5
			1,2-Dichloropropane	5
			Bromodichloromethane	5
			2-Chloroethylvinyl Ether	5
			Vinyl Acetate	10
			trans-1,3-Dichloropropene	5
			4-Methyl-2-Pentanone	10
			Toluene	5
			cis-1,3-Dichloropropene	5
			1,1,2-Trichloroethane	5
			Tetrachloroethene	5
			2-Hexanone	10

Table 7. Analytical Methods for Storm Water Analyses

Sample Numbers	Sample Matrix	Analytical Method	Analytical Constituents	Approximate Quantitation Limits (μg/L)
			Dibromochloromethane	5
			Chlorobenzene	5
			Ethylbenzene	5
			Total Xylenes	5
			Styrene	5
			Bromoform	5
			1,1,2,2-Tetrachloroethane	5
			1,3-Dichlorobenzene	5
			1,4-Dichlorobenzene	5
			1,2-Dichlorobenzene	5

a. Gas chromatography/flame photometric detection

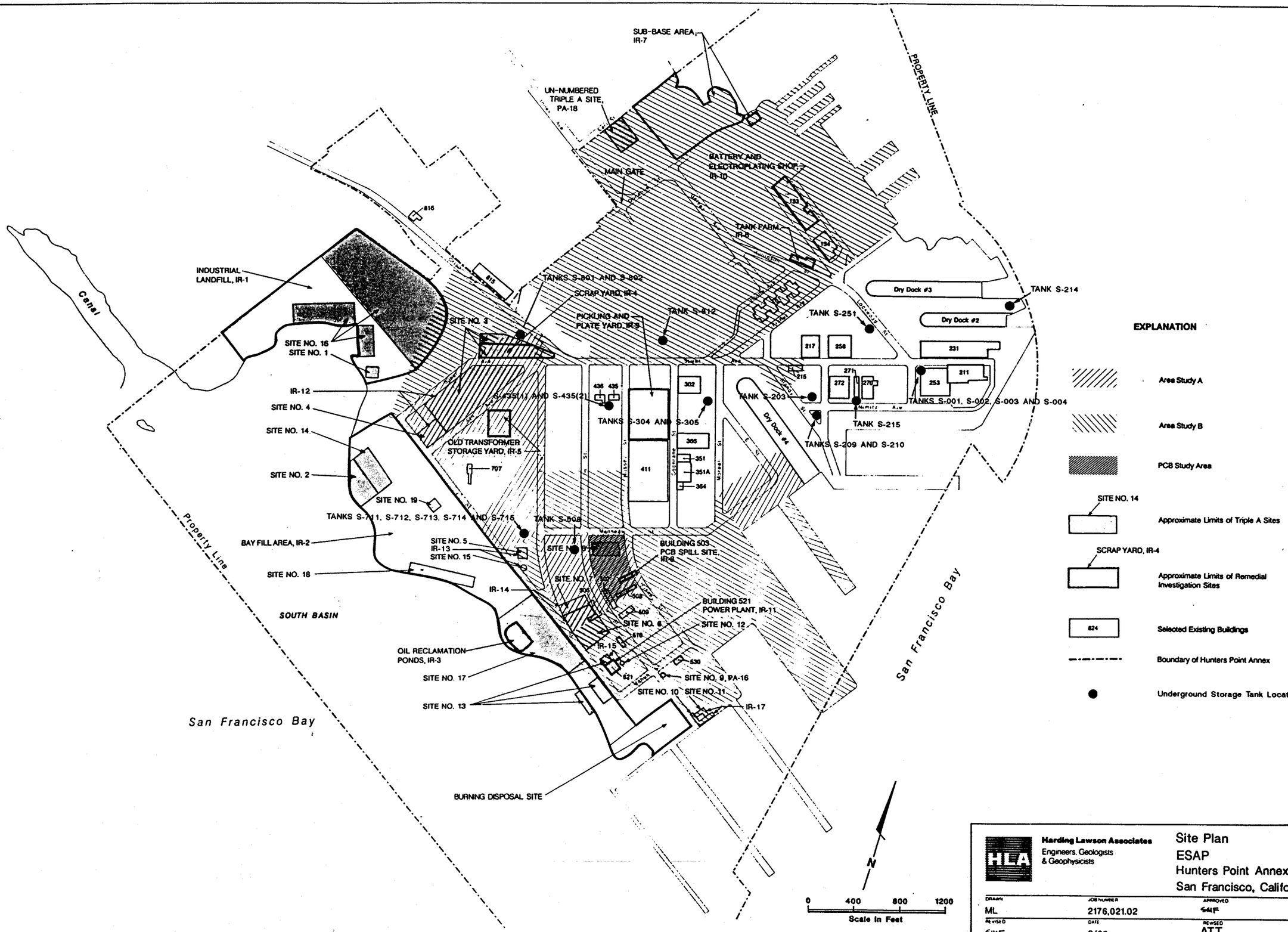


Harding Lawson Associates
Engineers, Geologists
& Geophysicists

Location Map
Environmental Sampling and Analysis Plan (ESAP)
Hunters Point Annex
San Francisco, California

PLATE 1

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
DM	2176,121.02	SMF	11/87	ATT	4/90



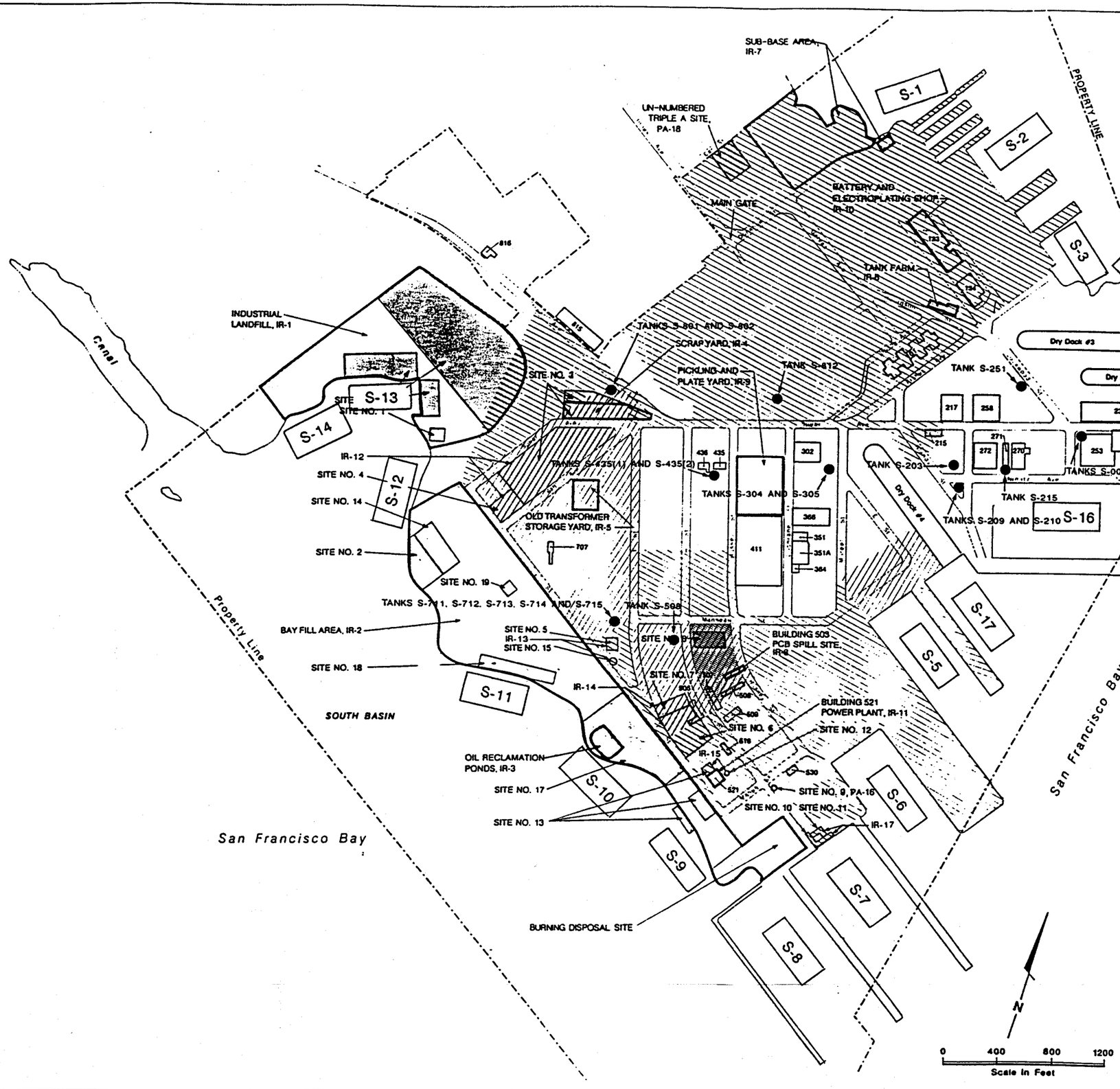
Harding Lawson Associates
Engineers, Geologists & Geophysicists

Site Plan
ESAP
Hunters Point Annex
San Francisco, California

PLATE 2

DRAWN	JOB NUMBER	APPROVED	DATE
ML	2176,021.02	GWF	11/87
REVISED	DATE	REVISED	DATE
GWF	2/88	ATT	8/90

2006



Note: All sediment samples will be collected from within HPA property boundaries.

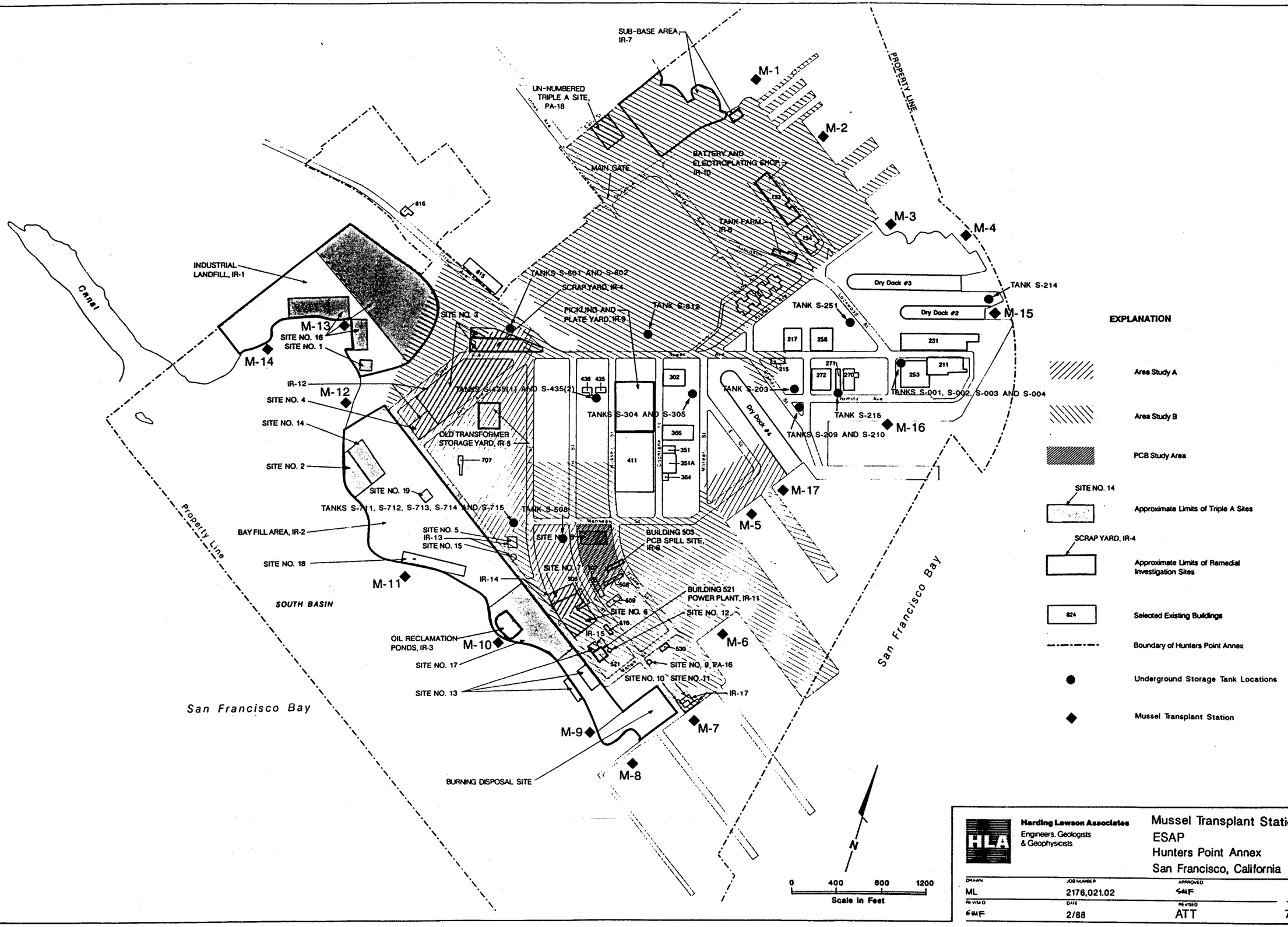
Harding Lawson Associates
Engineers, Geologists & Geophysicists

Sediment Station Areas
ESAP
Hunters Point Annex
San Francisco, California

PLATE 3

DRAWN	JOB NO.	APPROVED	DATE
ML	2176,021.02	SMF	11/87
RE-DRAWN	DATE	REVISED	DATE
SMF	2/88	ATT	7/91

2004



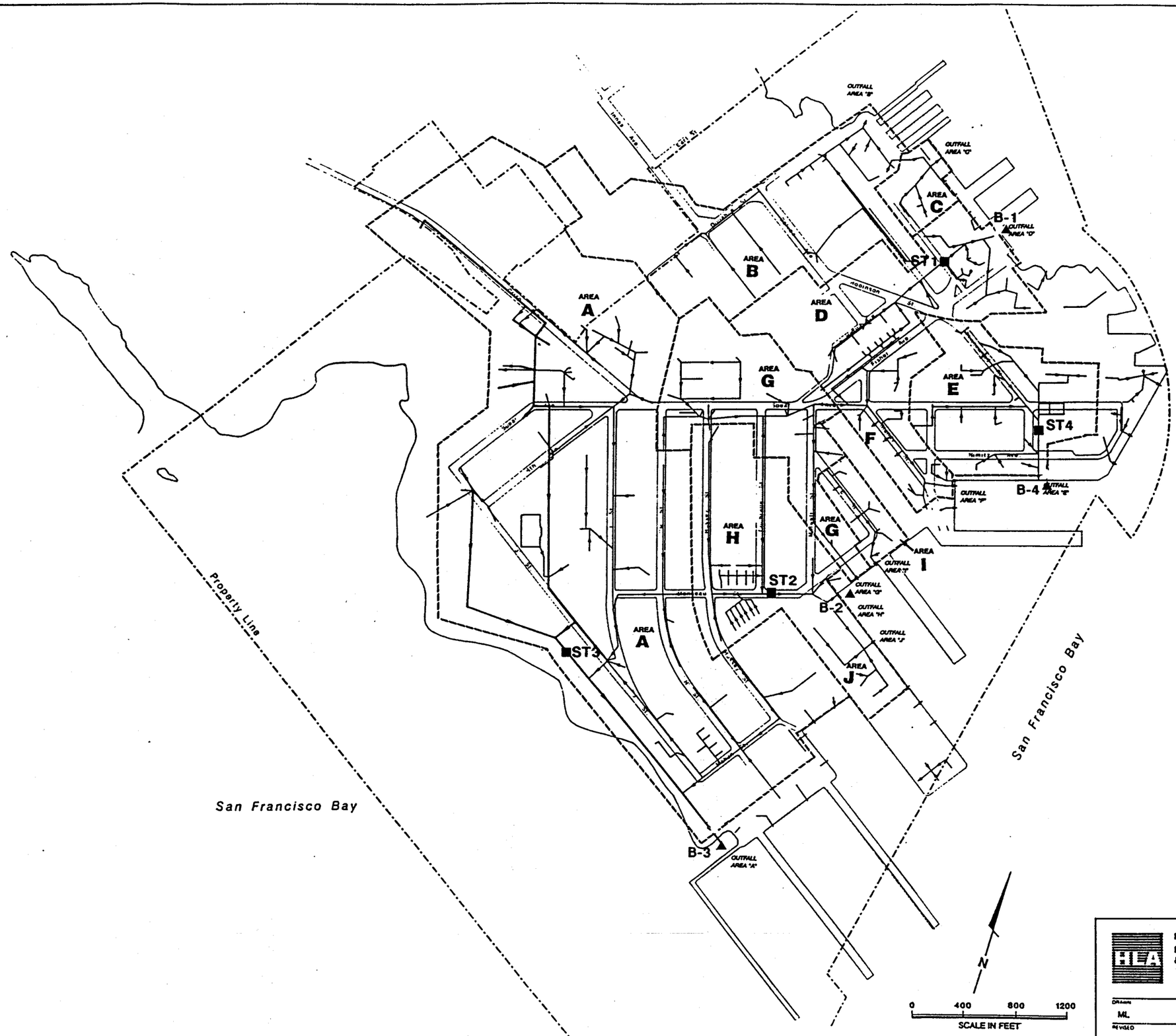
Harding Lawson Associates
Engineers, Geologists & Geophysicists

Mussel Transplant Station
ESAP
Hunters Point Annex
San Francisco, California

PLATE 4

DRAWN	JOB NUMBER	APPROVED	DATE
ML	2176,021.02	SMF	11/87
REVISED	DATE	REVISED	DATE
SMF	2/88	ATT	7/91

2986



EXPLANATION

- Existing Pipe
- New Pipe
- Boundaries for Drainage Area
- ■ Storm Water Sampling Point
- ▲ Bay Water Sampling Point

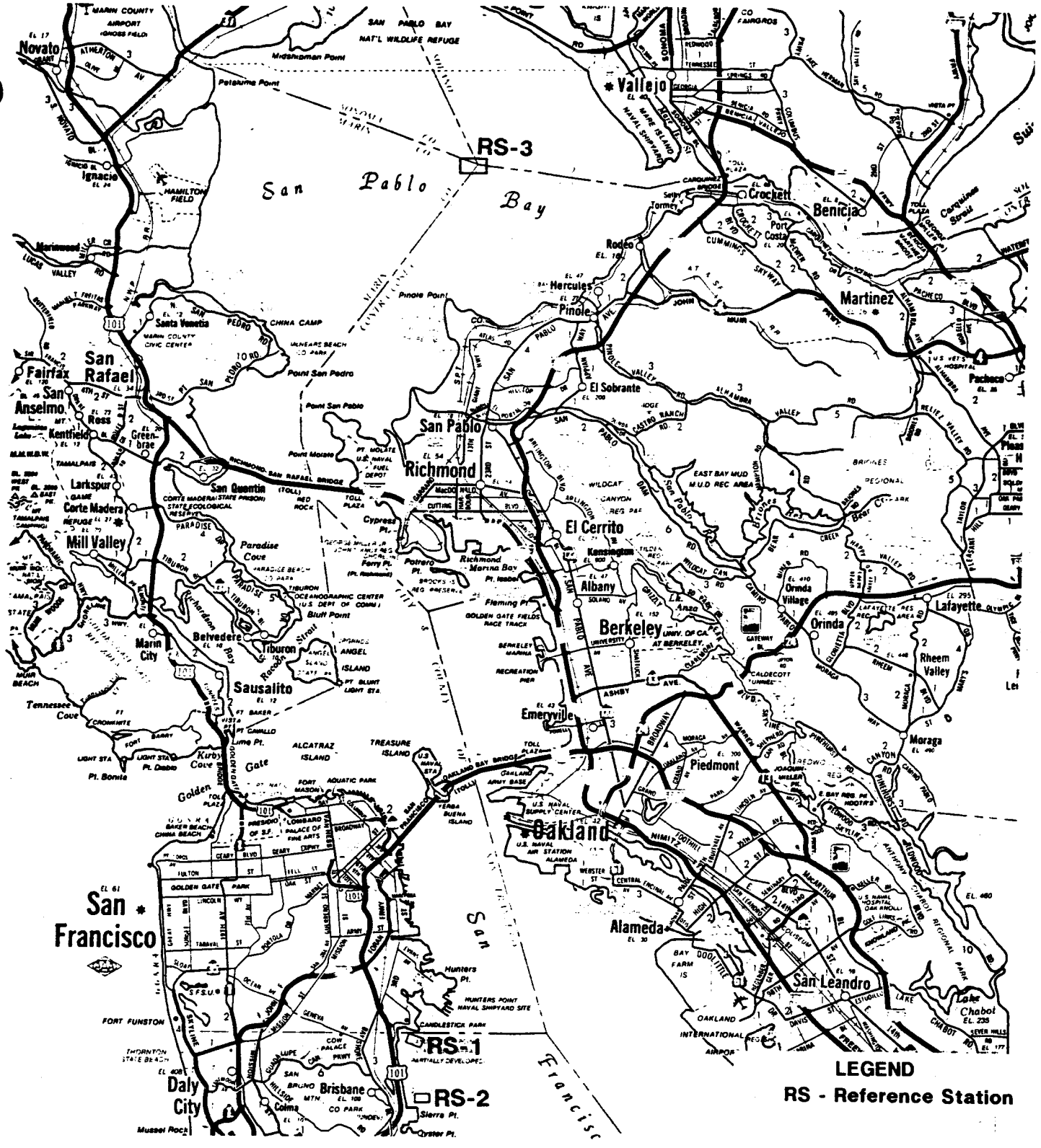
Harding Lawson Associates
Engineers, Geologists
& Geophysicists

Water Sampling Points
ESAP
Hunters Point Annex
San Francisco, California

PLATE 5

DRAWN	JOB NUMBER	APPROVED	DATE
ML	2176,253.02		
REVISED	DATE	REVISED	DATE
	12/89	ATT	8/90

16348



LEGEND

RS - Reference Station

0 1/2 1 mile

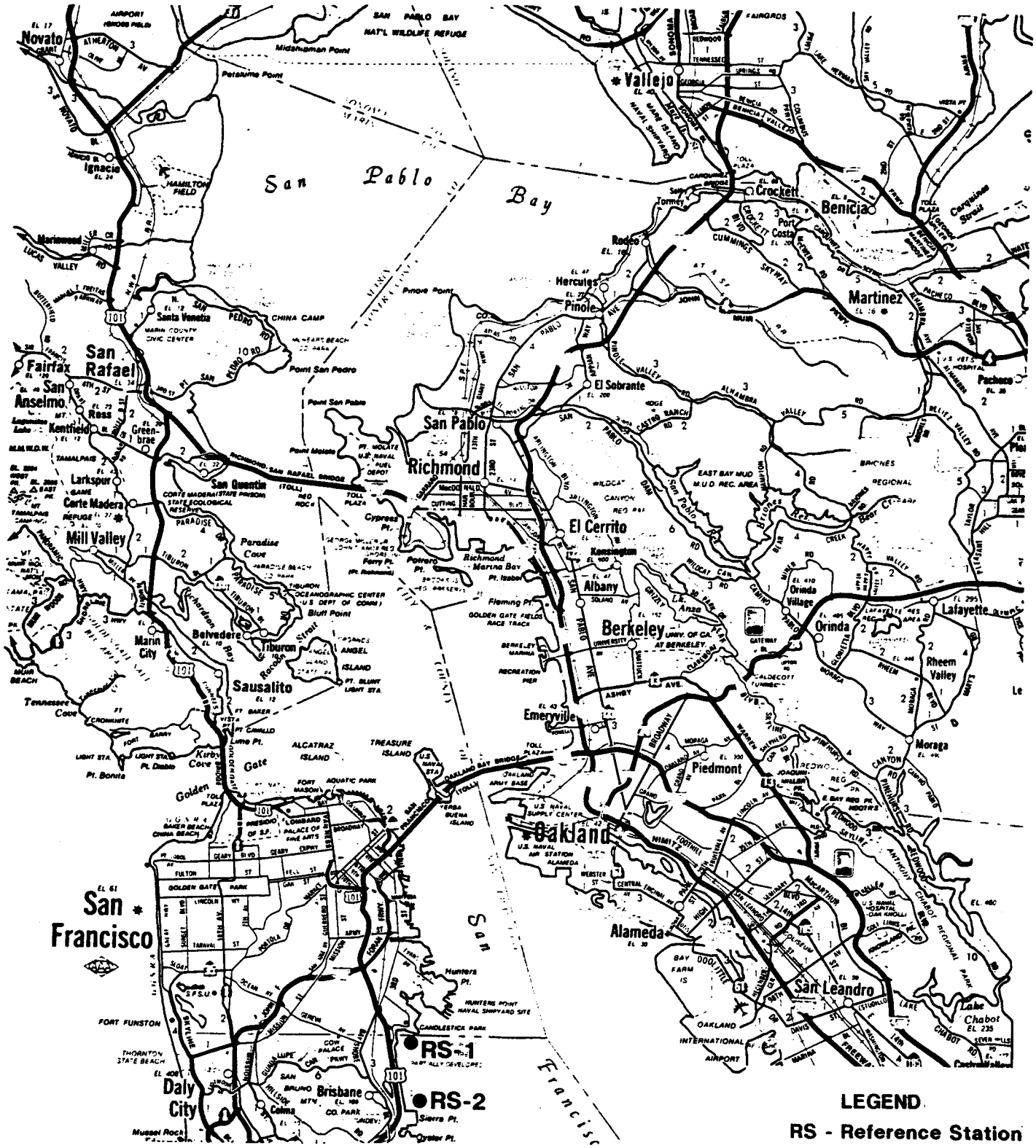
SCALE

N

Sediment Reference Station Areas

ATT Aqua Terra Technologies Consulting Engineers & Scientists

HLA-Hunters Point Annex, ESAP		PLATE
JOB NUMBER	DATE	
9118.3	7/91	6



Mussel Transplant Reference Stations

HLA-Hunters Point Annex, ESAP	PLATE 7
JOB NUMBER 9118.3	DATE 7/91

ATT Aqua Terra Technologies Consulting Engineers & Scientists

APPENDIX A

Agency Comments and Responses on ESAP

RESPONSE TO EPA AND NOAA COMMENTS ON THE MARCH 14, 1991 ENVIRONMENTAL SAMPLING AND ANALYSIS PLAN FOR HUNTER'S POINT ANNEX

Cover Letter:

NOAA has suggested to EPA that, given its scope, the ESAP be regarded as the equivalent of a Site Investigation (SI) for a new Operable Unit for the nearshore and offshore areas around HPA where site-related contaminants may have come to be located. Designating the ESAP as such may help put this effort into perspective, and clarify its relationship to the other OU as to the Ecological Assessment the Navy needs to undertake. We would like to further discuss this suggestion with the Navy, DHS, and the RWQCB, perhaps at the May 22 Technical Review Committee meeting.

Response:

We agree with the NOAA suggestion that the ESAP is the equivalent of an SI for the near shore and offshore areas. The Navy believes that it is important to evaluate first whether discharges from HPA are influencing sediment quality and water column quality offshore from HPA. If sediment chemistry and toxicity testing confirm sediment contamination, further investigations and the possible creation of a separate operable unit for the bay shore and marine sediments will be considered at that time. The reviewing agencies will be included in this decision-making process.

Comment #1: Page 2.2, Section 2.2.1. We are pleased that sampling areas have been added in the drydock areas.

Response: **No response necessary.**

Comment #2: Page 2-3, Sections 2.2.2 and 2.2.3. The revised plan still does not reflect a proper understanding of a "control" replicate versus a "reference" replicate. Control sediments should be collected from the location from which the test organisms are collected. These sediments should match the organisms natural environmental conditions in terms of grain size, sediment quality, etc. The purpose of this control replicate is to control for laboratory effects which may contribute to mortality but which have no relation to the sediments being tested. Thus, the control replicate is very important for quality assurance and quality control in the bioassay.

Reference replicates, in contrast, represent background conditions in a non-pristine area. The exact location of the reference site varies by program and test objective. (In the Ocean Dumping Program, the reference site is located in an area which is similar to conditions at the disposal site prior to the initiation of disposal. For the 404 program, the reference site is the disposal site). For the ESAP, a site in San Pablo Bay could be used as a reference site, since based on NOAA, 1988, some sites in San Pablo Bay show lower contaminant

levels than elsewhere in San Francisco Bay. However, these sites should not be considered *control* sites since all areas of San Francisco and San Pablo Bay have been subject to some amount of contamination.

If a site in San Pablo Bay is to be used as *reference* site, we recommend moving the sampling stations to the northern side of the shipping channel and away from potential land-based contamination sources. A 1987 NOAA Technical Memorandum (NOS OMA 35) entitled "San Francisco Bay Sediment Quality Survey and Analyses" contains data from a benthic survey conducted in San Pablo Bay. This document shows that fine-grained sediments are located in the center of San Pablo Bay. These sediments would be useful as reference sediments due to their location away from potential land-based sources of contamination and their similarity to the grain size of material found at Hunter's Point.

There may also be value in testing a reference replicate from the shoreline south of Hunter's Point to approximate conditions at Hunter's Point exclusive of contamination contributed by the Hunter's Point facility. The reference locations proposed in the ESAP may be appropriate for this purpose, subject to a review of known contamination sources in those areas.

To summarize the control vs. reference issue: the ESAP can use as many reference locations as are necessary but these locations should represent "background" levels located away from known discharges or contamination "hot spots". An appropriate control replicate must be tested for QA/QC purposes and should consist of pristine or nearly-pristine sediments and duplicate the natural conditions under which the test organisms are found.

Response: **In accordance with EPA's request for the designation of a more appropriate control area from which "pristine or nearly-pristine sediments that duplicate the natural conditions under which the test organisms are found", control sediments will be collected from the area in which the test organisms are collected (i.e. Bodega Bay). In the case that the test organisms are purchased from a commercial supplier, the control sediment will also be obtained from the supplier.**

The sediment station located in San Pablo Bay, formerly designated as "control stations" has been redesignated as a reference station. The station has however been relocated to the northern side of the shipping channel, away from potential land-based contamination sources, as recommended by EPA. The reference stations located south of HPA will be designated as background stations to approximate conditions in the vicinity of HPA exclusive of contamination contributed to San Francisco Bay by the Hunter's Point facility.

Comment #3: Page 2-4, Section 2.3.1. The reference to Table 4 in the paragraph at the top of the page should read Table 5.

Response: The table previously labeled as Table 4 (Analytical Methods for Metals/Inorganics) has been deleted as the analytical methods for metals are already contained in Tables 5, 6, and 7. The reference to Table 4 (List of Proposed Species) is now correct.

Comment #4: Page 2-4, Section 2.3.1. As discussed at the January 10, 1991 TRC meeting, the use of *E. estuarius* for the ESAP testing may be appropriate. However, the use of the amphipod *Rhepoxynius abronius* would allow comparison to previous sediment testing at Hunter's Point (for the Missouri Homeporting project): adding it as a test species would be helpful.

NOAA also recommends that the worm *Neanthes sp.*, for which the endpoint of growth would provide a more sensitive measure of toxicity than *Nephtys caecoides*, be added as well to the solid phase bioassay.

Response: The amphipod, Eohaustorius estuarius, selected by agency consensus at the TRC meeting January 10, 1991, is considered a more appropriate species for use in the sediment bioassays. The agency consensus reflects opinions of NOAA, the Department of the Interior, the California Department of Fish and Game, the California Department of Health Services (DHS), and the Regional Water Quality Control Board. Furthermore, the objectives of the Missouri Homeporting project were different than those of the ESAP. In addition, there are several technical reasons why Eohaustorius estuarius is a more appropriate test species. Although not finalized, the ASTM committee on sediment toxicity testing is recommending the use of indigenous species. R. abronius is not indigenous to San Francisco Bay. The 1991 EPA/COE manual also recommends that bioassay conditions should reflect natural conditions (i.e. water temperature, salinity, etc.) in the test area. A U.S.G.S. survey of salinity and temperature measurements in San Francisco Bay waters in 1981 recorded salinity measurements ranging from 3 to 30 parts per thousand (ppt) at a station located in the vicinity of HPA (Dedini, L.A., et al., 1981). The optimum salinity range for Eohaustorius estuarius is 3 to 25 ppt, whereas the optimum salinity range for Rhepoxynius abronius is greater than 25 ppt. For these reasons, E. estuarius will be used in the bioassay tests.

Nephtys caecoides was also selected as the marine worm to be utilized in the bioassay tests by agency consensus at the TRC meeting on January 10, 1991. It would appear at this time to be an unnecessary repetition of procedures to perform bioassay tests with both Nephtys caecoides and Neanthes sp.. Nephtys caecoides has been used successfully in sediment bioassays and is one of the EPA/COE Greenbook species recommended for use in sediment bioassays.

Comment #5: Page 2-5, Section 2.3.3. It is crucial to use test species of the same age. Experiments at the Marine Pollution Studies Laboratory have indicated the possibility of differences in toxicant sensitivity amount different aged mysids. If test species will be obtained from a commercial supplier of aquatic organisms, it is possible to receive many

brood stock cultured test organisms from the same age class in juvenile form. This approach would avoid speculation on age based on size or wet weight of the organisms. Also, to avoid underfeeding and cannibalism of *Holmesimysis costata*, test species should be fed *Artemia nauplii* in known amounts. If no *nauplii* are present in the aquarium after four hours, the amount of food should be increased slightly.

Response: **The test species used in the bioassays will be purchased from a commercial supplier of aquatic organisms. Test organisms used in the bioassays will be in the same age class.**

To avoid underfeeding and cannibalism of Holmesimysis costata, test species will be fed in known amounts. The test aquariums will be monitored closely and if, after four hours, no food (Artemia nauplii) is present, the amount of food will be increased. The ESAP has been revised to reflect this.

Comment #6: Page 2-5, Section 2.3.3. The 10% mortality check (20% for zooplankton) mentioned on page 2-5, should be applied to results from the control replicate as described above. This check was not intended for application to mortality occurring during the acclimation period.

Response: **The sentence "Less than 10 percent mortality of organisms (20 percent for zooplankton and larvae) in the holding tanks during the acclimation period will be necessary for use in the bioassays" has been deleted.**

Comment #7: Page 2-5, Section 2.4.1 first sentence. Will the 10 grab samples per area be located randomly in the area or in a grid pattern? The Navy should provide the proposed locations of all samples.

Response: **The 10 grab samples per sediment sampling area will be located randomly. Randomness of sample collection will be accomplished through a combination of boat movement and wind and water currents naturally moving the stern of the boat. It is impossible to identify exact sample locations within a station area at this time. However, sediment sample stations will be precisely located using Loran-C coordinates at the time of sampling. If natural factors are insufficient to achieve random sampling, the boat will be relocated within the sediment sampling area.**

Comment #8: Page 2-6, Section 2.4.1. What is the approximate volume of sediment that will be collected with the Peterson grab?

Response: **The sampling area of the Peterson grab is approximately 12 in^2. A penetration depth of 4 inches is expected for sediments surrounding HPA (muddy sediment). Therefore the approximate volume of sediment that will be collected by the Peterson grab is 48 cubic inches. The volume collected would decrease if coarser sediment (fine to medium-coarse**

sand) is encountered because the penetration depth decreases with increasing sediment grain size and compaction.

Comment #9: Page 2-6, Section 2.4.1. In the discussion of the radiation measurement that appears in the middle paragraph, please clarify what level of exceedence would be deemed "above background." Also, the Data Quality Objectives, and precision and accuracy goals, of the lab analyses for radioactivity, should be presented here or in the QAPP.

Response: The level of exceedence "above background" that will cause the sediment to be submitted for radiation analysis will be any alpha, beta or gamma radiation above the mean radiation level measured in control sediments which is greater than radiation detection limits. Background radiation levels are defined as the mean radiation level + 3 standard deviations in control sediments. A minimum of 10 sediment samples from the control area will be screened in order to calculate the mean radiation level and 3 standard deviations. The Data Quality Objectives and precision and accuracy goals for the radiation analyses have been included in the revised QAPjP.

Comment #10: Page 2-6, Section 2.4.1. In the next to last paragraph, please clarify the statement made in the next to last sentence that the container will be stored "until analyzed". Which analysis does this refer to? This statement implies a "rush" analysis if the samples are to be used in a test starting within 7 to 10 days of sample collection. How will the Navy ensure timely analysis of these samples?

Response: The wording has been changed from "until analyzed" to "until the sediment is utilized in the bioassay tests". The Navy will ensure "timely analysis" by sending collected samples immediately (same day or following day) to the bioassay laboratory following the removal of samples for chemical and physical analysis. The holding time for samples to be used in bioassays is 14 days. The samples will, in no case, be held for a time period exceeding this holding time.

Comment #11: Page 2-7, Section 2.4.1. The second line of the page references "Section 2.9". As there is no Section 2.9, should this be 2.7?

Response: The reference to Section 2.9 has been changed to Section 2.7.

Comment #12: Page 2-7, section 2.4.1. How long will the samples collected for TBT analysis be frozen before analysis?

Response: The holding time allowed for sediment samples collected for tributyltin analysis is 28 days as specified in Table 2 of the QAPjP. Samples will be sent to the laboratory immediately (same day or next day) following collection. Samples will be analyzed within the required holding time and will remain frozen until analysis.

Comment #13: Page 2-7, Section 2.4.2. As we stated in our last comment letter, it is very important that the sediment sampling indicate the contamination of surficial sediment relative to the quality of the underlying sediments. The stratified core samples are useful in providing more information on this issue but a larger number of samples from the deeper sediments will be necessary to address the question. Also, due to differences in sampling equipment, sampling location and handling, it is not advisable to attempt to compare the sediment chemistry results from the bottom 6 inches of the core samples with the composite surficial samples from the grabs. Therefore, we recommend using cores for the ten samples per area rather than the proposed grabs.

If cores are used, sediments can be composited from the tops of the 10 core stations for bioassays and chemical analyses and from the bottom of the cores for chemical analyses. The sampling areas will be evaluated on the basis of the bioassay results from the tops of the cores. The level of contamination in surficial sediments can be compared to deeper sediments using the sediment chemistry results from the top and bottom core samples. In addition, cores may be better sampling devices than grabs due to opportunities for excessive leakage and disturbance of sediments with grabs and the auxiliary information provided by cores on sediment stratification.

In order to compare results from the ESAP to previous sediment testing in the area, it is imperative that the water depth and depth of penetration of the cores be recorded during sampling and provided in the final report. Previous testing for the USS Missouri Homeporting Project showed that sediments below-44 feet were more highly contaminated than sediments above-44 feet. It will be important to evaluate which, if any, of the sediments below-44 feet are sampled as part of the ESAP. If possible, it would be useful to review bathymetric survey information from the sampling areas prior to actual sediment sampling.

Response: **The primary focus of the ESAP sediment sampling program is to evaluate potential contamination of surficial sediments in the vicinity of the HPA because contaminants in surficial sediments have the greatest potential for toxicity to benthic species. Benthic species generally live within the first several centimeters of the sediment. Sediment grab sampling provides a more representative sample of sediments in which benthic species reside and where potential exposure to contaminants occurs because they allow for a greater surface area to be investigated as compared to the two-inch diameter core sample. The grab sampler provides a greater sample volume of surficial sediments than would a surficial core sample necessary for chemical analyses and bioassay testing. Furthermore, the objective of the ESAP is to evaluate whether contamination is present in the sediment surrounding HPA as opposed to assessment of toxicity in the full thickness of sediment that may be dredged which is the objective of the EPA/COE Evaluation of Dredged Material Proposed for Ocean Disposal - Testing Manual (Greenbook). Sediment core samples were added to the ESAP program, at the request of the agencies, to determine if contaminants are present in deeper sediments that might potentially be exposed through current scouring.**

To improve comparability of grab and core samples, analysis of grain-size and total organic carbon has been added to the program. Water depth and depth of penetration of the cores will be recorded during sampling. The ESAP coring program is designed to include sediment sampling at similar depths to the Homeporting Project. Depth to core samples in the USS Missouri Homeporting Project was given in feet below sea level. Water depth in the area sampled (dry docks) was approximately 43 feet. Therefore, sediment cores were collected at one to three feet below the sediment-water interface, equivalent to 44 to 46 feet below mean sea level.

Comment #14: Page 2-7, Section 2.4.2, last paragraph. Please note comment 28 concerning analytical methods and detection limits. The specific methods cited here may not be the most appropriate for this project.

Response: **See response to comment 28.**

Comment #15: Page 2-7, Section 2.5, and Page 2-11, Section 2.6. 2.1. EPA recommends that artificial seawater be aged for 1 to 2 weeks after preparation and intensively aerated before use. In addition, prepared seawater should be passed through a properly maintained ultraviolet sterilizer or a filter effective to 0.45um or less. These recommendations are based upon "ASTM Proposed New Standard Guide for Conducting 10-day Static Sediment Toxicity Tests with Marine and Estuarine Amphipods."

Response: **As per the 1991 EPA/COE Greenbook (p. 11-14, Section 11.2.1.4), the artificial seawater will be prepared in strict accordance with manufacturer's instructions. The artificial seawater will be allowed to age, with aeration, for at least one week, prior to use in the bioassay tests. As per ASTM recommendations, the seawater will be filtered prior to use if a residue or precipitate is present after aging.**

Comment #16: Page 2-8, Section 2.6. It is very important that a laboratory with experience in conducting sediment bioassays perform the testing outlined in the ESAP. Facilities, equipment and personnel qualifications should be reviewed and approved prior to initiation of the testing.

Response: **The Aqua Terra Technologies bioassay laboratory QA/QC document, which includes facility descriptions, laboratory equipment, test procedures, QA/QC protocols, and laboratory personnel qualifications will be provided to the agencies requesting the document. The agencies are welcome to visit the laboratory prior to the bioassay testing, as well as during the testing for the purpose of reviewing the laboratory facilities, QA/QC procedures, and interviewing technical staff for their qualifications.**

Comment # 17: Page 2-8, Section 2.6.1.1 and 2.6.1.2. We recommend using a 0.5 mm sieve any time organisms are to be removed from sediments and also for consistency.

Response: Although the 1991 Greenbook (Page 11-15, Section 11.2.1.5) recommends the use of a 1.0 mm screen for recapture of the test organisms, a 0.5 mm sieve will be used to separate organisms from sediment during sieving procedures as requested by EPA. The ESAP and QAPjP texts has been changed to reflect this.

Comment #18: Page 2-10, Section 2.6.1.6. According to the EPA/Corps of Engineers' "Draft Ecological Evaluation of Proposed Discharge of Dredged Materials into Ocean Waters, 1990," page 10-23, ammonia should also be measured since the ESAP's proposed testing follows the static renewal design.

Response: Ammonia has been added as a water parameter to be monitored during static-renewal bioassay tests as per EPA/COE Greenbook requirements (Section 11.2.1.5, page 11-16).

Comment #19: Page 2-10, Section 2.6.1.9., and page 2-13, Section 2.6.2.9. Statistical procedures given in the revised ESAP are modified from the previous version of the ESAP but are still not entirely correct. For the solid phase bioassay data, if Levene's test indicates that the data are parametric, an ANOVA should be performed. If the results of the ANOVA suggest that statistically significant differences between group means exist, then the means should be tested using Dunnett's test. If Levene's test shows the data are non-parametric, a non-parametric ANOVA, the Kruskal-Wallis test, should be performed, followed by a Wilcoxon test if necessary. These procedures are given in EPA/Corps of Engineers' "Draft Ecological Evaluation of Proposed Discharge of Dredged Materials into Ocean Waters, 1990, Chapter 12. The statistical procedures described for the Liquid/Suspended Particulate Phase tests are appropriate.

Response: Levene's test for the homogeneity of variances will be performed first to test for the validity of the assumptions of normality and constant variance. If Levene's test shows that the data is parametric, the analysis of variance (ANOVA) and associated multiple comparison procedure known as Dunnett's Test will be performed. If Levene's test shows that the data is non-parametric (does not satisfy ANOVA assumptions of normality and constant variance), a non-parametric test (i.e. Kruskal-Wallis test) will be performed for comparison, followed by a Wilcoxin test, if necessary. The ESAP has been changed to reflect EPA recommendations.

Comment #20: Page 2-12, Section 2.6.2.4. The ratio of sediment to water cited here should be 1:4 not 4:1.

Response: The sentence has been changed to "The 1:4 sediment-water mixture . . .".

Comment #21: Page 2-13, Section 2.7, second paragraph. The reference to Table 5 should instead cite Table 6.

In the following paragraph, please note that EPA does not *certify* CLP laboratories. (This comment also applies to page 2-14, Section 2.8, last bullet.)

Response: **Table 4 (Analytical Methods for Inorganics/Metals) has been deleted as the analytical methods for metals are already contained in Tables 5, 6, and 7. The reference to Table 5 (Analytical Methods for Sediment Analyses) is now correct. The reference to "EPA certified CLP laboratories" has been changed to "Laboratories utilized for chemical analysis will meet the CLP requirements and standards for equipment, personnel, laboratory practices, analytical operations and quality control operations and follow CLP standard protocol".**

Comment #22: Page 2-14, Section 2.7. EPA continues to recommend the Rice et al., 1987 method for TBT given in the EPA/Corps of Engineers' "Draft Ecological Evaluation of Proposed Discharge of Dredged Materials into Ocean Waters", 1990. If the Rice method is not to be used, please provide us with a protocol or reference for the method to be used. We will need to review the protocol before we accept any analyses for TBT.

Response: **The references for the proposed analytical methods for the analysis of tributyltin are as follows:**

> **Durell, Gregory S., and Allen D. Uhler, "Measurement of Butyltin Species in Tissues by n-Pentyl Derivatization with Gas Chromatography/Flame Photometric Detection (GC/FPD) and Optional Confirmation by Gas Chromatography/Mass Spectrometry (GC/MS), Battelle Ocean Sciences, Duxbury, MA., Laboratory Project Number N-0519-6300, Submitted to the Consortium of Tributyltin Manufacturers, M&T Chemicals, Inc., and Sherex Chemicals Company, Inc., February 22, 1989.**
>
> **Uhler, Allen D., and Gregory S. Durell, "Measurement of Butyltin Species in Sediments by n-Pentyl Derivatization with Gas Chromatography/Flame Photometric Detection (GC/FPD) and Optional Confirmation by Gas Chromatography/Mass Spectrometry (GC/MS), Battelle Ocean Sciences, Duxbury, MA., Laboratory Project Number N-0519-6100, Submitted to the Consortium of Tributyltin Manufacturers, M&T Chemicals, Inc., and Sherex Chemicals Company, Inc., February 28, 1989.**

Copies of these references will be forwarded for your review.

Comment #23: Page 3-4, Section 3.5. How long will mussels be frozen before analysis? The SMW Program holds tissues for 6 months.

Response: **The holding time for mussel tissue for analysis for tributyltin is 28 days. Tissue samples will be sent to the laboratory immediately (same day or following day) following collection. Tissue samples will be analyzed within the holding time and will remain frozen until analyzed.**

Comment #24: Page 4-2, Section 4.2.1. In the list at the top of the page, please note that the drawing on Plate 5 appears to show that IR-10's drainage goes to the Area B outfall, not the Area D outfall that will be sampled at ST1. There is no sampling point for the Area B outfall.

Response: The locations of the storm water sampling stations were selected to coincide with the Harding Lawson Associates' (HLA) "Water Quality Investigation of Storm Water Drainage" so that the data resulting from the ESAP storm water sampling can be compared to the previous HLA study results. ST1 was selected to monitor runoff from the IR-6 site. IR-10 was erroneously added as a site associated with runoff collected at station ST1, and has been removed from the table on page 4-2.

Comment #25: Page 4-2, Section 4.2.2. Please describe how the bay water samples will be compared to the storm water samples.

Response: The salinity measurements, bioassay results, and chemical analytical results of bay water samples will be utilized as a comparative reference for storm water drain samples. Data resulting from the analyses and bioassay testing will be qualitatively compared through the use of tables and graphs.

Comment #26: Page 4-2, Section 4.2.3, and page 4-4, Section 4.4.3. Is this sampling point intended to be a "reference" sample or a "control" sample? Please see our comment 2 above, and clarify the intent of this section. Please also note your response to comment #34 in our original comment letter; this response seems to contradict this text.

Response: The San Pablo Bay sampling point will be used as a reference water sampling point. The reference water sample will be collected and prepared for use in the reference bioassay by diluting it to the same salinity as the bay water sample.

Comment #27: Page 4-6, Section 4.7.2.2. What will the storm water runoff dilutions be? A dilution factor of 0.5 is recommended. What will the sperm and egg stock dilutions be? These cannot be based on protocol for the East Coast species, *Arabacia punctulata*, since species-specific differences in control fertilization depend upon sperm:egg ratios. Refer to the following reference for details on *Strongylocentrous purpuratus* and *Dendraster excentricus* fertilization tests:

> Dinnel, P., J. Link, and Q. Stober, 1987. Improved methodology for a sea urchin sperm cell bioassay for marine waters. Arch. Environ. Contam. Toxicol. 16: 23-32.

Response: Storm water runoff dilution factor will be 0.3 as stated in Section 4.6.3. ASTM protocol for echinoderm fertilization success tests requires greater than 70% fertilization for Strongylocentrus purpuratus and Dendraster excentricus. ASTM recommends using the lowest sperm to egg ratio that will achieve this goal. The ATT bioassay laboratory utilizes a 90% fertilization goal. Starting with a 1000 to 1 sperm to egg ratio, the ratio is decreased

(500 to 1, 300 to 1,etc.) until the lowest sperm to egg ratio with 90% fertilization is achieved. Generally, for Strongylocentrus purpuratus and Dendraster excentricus fertilization success tests, 90% fertilization has been achieved with a sperm to egg ratio of 300 to 1.

Comment #28: Table 6. The approximate quantitation limits for the inorganics in Table 6 should be reported in mg/kg as discussed on pg. 4, Response to NOAA Comments on Draft ESAP.

Many of the detection limits and methods in Table 6 differ from those recommended for sediment testing under EPA's Ocean Dumping Program. A list used by the Ocean Dumping Program is attached for your reference. We acknowledge that the different objectives of the dredged material testing program and the ESAP may result in different acceptable detection limits and methodology. As other Agencies have noted, however, adherence to methods normally used for evaluating human health risks at Superfund sites may not be appropriate for this ecological assessment.

NOAA has noted that the CLP detection limits are based on the drinking water MCLs, which may be higher than certain chronic ambient water quality criteria (AWQC) established for the protection of aquatic life. As noted in NOAA's previous comments (see Response to NOAA Comments, pages 3-4), lower detection limits should be achieved to adequately assess potential impacts on aquatic organisms.

Response: **Table 5 (previously Table 6) has been revised to clarify quantitation limit values.**

Detection limits requested by NOAA (ER-L levels) can be achieved for analytes of concern except for Endrin. Achievable detection limits for Endrin by laboratories consulted varies from 2.5 ppb down to 0.5 ppb. If a laboratory that can achieve a detection limit of 0.02 ppb can be identified by the regulators, we will utilize that laboratory.

RESPONSE TO EPA COMMENTS

Comment #29 (Comment #5): We still question the logic of assessing the effects of acute toxicity only from sediments and the effects of bioaccumulation of contaminants only from water column (mussel) bioassays. Bioaccumulation could be an important adverse environmental effect from sediments as well. Sediment chemistry testing could be completed before starting the bioaccumulation testing, to avoid scanning for bioaccumulated contaminants which are not present in the sediment. In this way, analytical costs can be minimized by testing tissues for only those contaminants showing sediment chemistry levels high enough for bioaccumulation potential.

We suggest 28-day sediment bioaccumulation testing be strongly considered as a follow-up procedure to the sediment chemistry testing should elevated levels of contaminants be observed. Such follow-up should be addressed in the Ecological Assessment workplan the Navy is to develop.

Response: Follow-up sediment bioaccumulation testing will be considered after the initial sediment chemistry results have been reviewed.

Comment #30 (Comment #16): The response indicates that the DO level will be maintained at a minimum of 5 ppm. Pages 2-8 and 2-9, however, state that "Dissolved oxygen will be maintained above 4 ppm." These statements should be changed to reflect the response in Appendix A.

Response: The EPA/COE "Greenbook" (1991) states that the dissolved oxygen content should be maintained above 40% saturation. The ESAP has been changed to reflect the latest version of the Greenbook.

Comment #31 (Comment #19): See comment 19 above concerning statistical methods. Also note that any additional statistical analyses used need to be approved by the regulatory agencies in advance.

Response: See Response to Comment #19 above.

Comment #32 (Comment #26): The response describes what the two programs objectives are and not how the analysis data will be compared. The answer implies that no comparison is possible due to the significantly different set of objectives. If this is a valid assumption, a statement in the ESAP should indicate that no baseline data exists for comparative purposes.

Response: Comparison of data results from the ESAP bioaccumulation (mussel transplant) program may not be directly comparable to data obtained in the State Mussel Watch Program. Depending on the location of some SMW mussel watch stations, data from these stations may be used to supplement background data uptake of chemicals into mussel tissue. However, because the bioaccumulation of chemicals into tissue is a relatively rapid process, the 30 day mussel deployment period is satisfactory to address the objectives of the ESAP.

RESPONSE TO NOAA COMMENTS

Comment # 33 (Page 3) NOAA has commented on the response at the top of page 3 as follows:

> The (Draft Final) ESAP holds fast to the notion expressed in the draft "Green Book" that differences between control and test survival should be equal to or greater than 10% before predictions of probable field impacts can be made. While a 10% difference is a good generality for a true difference between test results, there may be times when a significant statistical difference which is less than 10% is true and it is important to observe those times.

Response: **It is acknowledged that a statistical difference between control and test survival less than 10% may be significant in certain instances. Conversely, there are instances in which the statistical difference which is greater than 10% is also valid for making predictions. In the event statistical differences less than or greater than 10% occur in the data, it will be recorded and reported in the ESAP report. Bioassay responses at all stations will be compared to one another by using Tukey's Studentized Range (HSD) test to determine which stations differ significantly from control stations. Other statistical analysis may be considered in the interpretation of the data. However, exact statistical consideration cannot be made until the data are reviewed. Upon collection and review of data, appropriate statistical analysis will be applied based on the form of the data.**

ATT

RESPONSE TO DHS COMMENTS ON THE DRAFT FINAL ENVIRONMENTAL SAMPLING AND ANALYSIS PLAN HUNTERS POINT ANNEX

General Comments

Comment #1 The ESAP does not delineate the types of benthic communities occurring in San Francisco Bay surrounding the Hunters Point Annex. Specifically, can the submerged and exposed portions of the inlet between Hunters Point Annex and Candlestick Park be described as a wetland? A wetland delineation should be performed at Hunters Point Annex to determine if this area qualifies as a wetland. Recognition that this area is a wetland would require an additional suite of ecological measurements besides those specified to investigate the submerged soft-bottom benthic community surrounding the remainder of Hunters Point Annex.

Response: A preliminary wetlands identification has been performed by Navy biologists. The results will be made available to the agencies. A more formal wetland delineation will be performed, at a later date, as part of the Ecological Risk Assessment.

Consideration for performing "additional suites of ecological measurements" will be made at a later date, when information resulting from the formal wetland delineation is available.

Comment #2 Population-level and community-level comparison of the submerged soft-bottom benthic community surrounding Hunters Point Annex with other similar habitats are specifically excluded from this ESAP. "Lack of comparative background information" and other factors are cited (page 1-1) as the basis for this exclusion. Population-level and community-level differences may provide the most sensitive and real-world measure of the ecological impact of contaminants from Hunters Point Annex. Comparative soft-bottomed sediments will be sampled in San Pablo Bay as the control site for sediment exposure experiments. The San Pablo Bay sediments will be sieved as part of the sediment preparation. Taxonomic identification and enumeration of the entrained biota would provide the "comparative background information" required to make population-level and community-level comparisons. We do not agree with other justifications for no benthic community studies in the response to a similar comments by the Department of Fish and Game (Appendix A, page 5). While it is true that some "diversity studies take several years", the length of study is frequently related to the degree of community structure between the San Pablo reference station and Hunters Point Annex would be immediately apparent and might be an indication that some difference in sediment contamination was responsible.

And, while it is also true that "results of such benthic studies has provided little input into the determination of whether sediments are contaminated", the results of such studies are typically evidence supporting or refuting the impact of chemically-determined sediment contaminant concentrations. We strongly urge that these minimal benthic community comparison be conducted and included in the ESAP.

Response: **The ESAP is proposed as a preliminary investigation to evaluate whether contaminants are present at levels that may be of concern through chemical analysis and toxicity testing. The types of studies suggested by DHS go beyond the objectives of the ESAP and are not appropriate at this time. If contaminants are present in the sediments at concentrations which may impact benthic organisms, benthic level studies may be considered. Benthic studies are more appropriate in the evaluation of remedial alternatives of contaminated sediments.**

Comment #3 We have serious concerns regarding the use of procedures intended to test the effect of ocean disposal of dredged material, modifying those procedures and interpreting the results as indicative of the in-place toxicity of Hunters Point Annex sediments (page 2-8, Section 2.6). There are significant differences between the solid-phase bioassay procedures of the "Draft Ecological Evaluation of Proposed Discharge of Dredged Materials into Ocean Waters" (EPA/COE), January 1990, American Society for Testing and Materials benthic bioassay guide (ASTM E1367) and the "modified" solid phase bioassays of the ESAP. Solid-phase bioassay with amphipods should follow the guidance in Swartz, et al., 1985. EPA/COE and ASTM guidance on exposure chamber cleaning, holding mortality, control mortality, reference-toxicant bioassays, test condition monitoring, and artificial sea salt preparation should be followed in all bioassays.

Response: **The solid-phase static-renewal bioassay methods originally proposed in the ESAP are those recommended in the EPA/COE Greenbook manual for static-renewal type bioassays. These methods have been revised to conform with Swartz, et al, 1985. The static-renewal methodology has been retained as a modification to the Swartz, et al. method to simulate estuarine tidal conditions. It is acknowledged that the Greenbook is designed for dredged disposal of sediment. However, EPA required that the Greenbook protocol be used for the sediment bioassays with modifications. This was generally agreed upon by all agencies, including DHS, at the January 10, 1991 TRC meeting.**

Comment #4 The Quality Assurance Project Plan for Environmental Sampling refers to the storm water samples collected in December 1990 as having been already analyzed for volatile organic compounds (VOCs),

semivolatile organic compounds (SOCs), pesticides, and polychlorinated biphenyls (PCBs), total petroleum hydrocarbons (TPHs), metals, oil and grease and pH (Section 3.2, page 2). These results would be useful in evaluating the proposed storm water runoff testing protocols (Section 4.0), but have yet to be released. The storm water runoff tests outlined in the ESAP should be considered proposed tests until the results of the December 1990 water analyses are available for review.

Response: The ESAP storm water testing locations have been reviewed in light of the December 1990 storm water sampling results. A brief summary of the HLA "Water Quality Investigation of Stormwater Drainage" results has been added to Section 1.4.2 of the ESAP.

Comment #5 The level of detail supplied varies widely throughout the ESAP, with no apparent relationship to importance. For example, the reader is supplied with the type of pencil to be used to write on the sample bags, but is left to guess the meaning of phrases like "Synergistic, antagonistic, and additive effects of chemical, physical, and biological components..." and"...physiological and biochemical functions in the test species".

Response: The terms "synergistic, antagonistic and additive" have been removed from the text and replaced with "toxic". The use of these terms neither adds nor subtracts from the ESAP protocols.

Comment #6 Jargon should be avoided when a commonly-understood term will suffice. If no common term adequately conveys the intended meaning, the jargon should be defined. The word "surficial", for example, which can only be found in a geology dictionary, can be replaced with superficial with no loss of meaning.

Response: The American Heritage Dictionary of the English Language defines "surficial" as: "of, pertaining to, or occurring on the earth's surface." The term "superficial", however, has multiple definitions such as "on the surface", "apparent rather than actual or substantial", and "insignificant". "Surficial" is more concise and is acceptable terminology for a technical document.

Specific Comments

Comment #1: Total Threshold Limit Concentration (TTLC) levels are used for comparison with metal concentrations in the sediment off Hunters Point Annex (page 1-5). TTLC levels are regulatory levels used to characterize hazardous wastes and are not cleanup levels. Metal or organic concentrations in sediment could be below the TTLC and still make a considerable

contribution to the ecological risk posed by contaminants at Hunters Point Annex. Sites with sediment contamination should not necessarily, be excluded from further sampling because the contaminant concentration falls below the TTLC. Similarly, contaminants with concentrations below the TTLC level should not, necessarily, be excluded from further consideration in the ESAP. Subsequent risk assessment using Toxic Substances Control Program-approved methodology involves the determination of the upper confidence limit on the mean value for each chemical. The most important chemicals (e.g., those accounting for 95 percent to 99 percent of the total cancer risk or hazard index) must be carried through the calculations.

Response: **It is recognized that Total Threshold Limit Concentration (TTLC) levels are regulatory levels used to characterize hazardous wastes and are not clean-up levels. The reference to TTLC levels in the ESAP was included as part of the summary of results from the Environmental Impact Statement (EIS) prepared by ESA in 1987. Results are given in the ESAP as they were presented in the original document. ESA stated in the EIS that comparison of bulk sediment chemistry test data with TTLC levels is not necessarily indicative of the potential for ecological effects from dredging or aquatic disposal of dredged material. This information was included for the sole purpose of providing information of past environmental studies conducted in marine sediments in the vicinity of HPA. Sample stations for the ESAP were not based on the results of previous studies. Metals and organics are included in the analytical program for all media (sediment, tissue, and storm water) identified in the ESAP.**

Cancer risk and hazard index are used in public health risk assessments and are not necessarily applicable to environmental risk assessments. However, if applicable, some results from the ESAP may be used in the PHEE.

Comment #2: The applicability of the aquatic toxicity studies performed as part of the Environmental Impact Statement (EIS) of the potential effects of homeporting ships at Hunters Point Annex is not readily apparent. The fact that none of the suspended particulate phase bioassays "indicated that the Limiting Permissible Concentration (LPC) would not be exceeded during disposal of sediments from Hunters Point Annex" (page 1-5) does not appear germane, particularly as the solid-phase amphipod bioassays showed significant mortality. The bioassays performed as part of the homeporting EIS were designed to evaluate the impact of the settled dredge spoil after ocean disposal based on instantaneous, continuous or hopper-dredge discharge models. This ESAP is to gather information for an assessment of the impact of Hunters Point Annex on in-place biological receptors, not the impact of ocean disposal of dredge spoil.

Response: As stated above, the information provided in the ESAP regarding the EIS was included as background information available from previous investigations of sediments in waters off HPA. The EPA requested that this background data be included in the ESAP. We recognize that the data collected during implementation of the ESAP and data from these previous studies may not be directly comparable.

Comment #3: What are the "regulatory target levels" (page 1-5, last line: which all the dredge sediment analytes were below? Are these TTLC levels, Department of Health Services (DHS) Applied Action Levels (AALs) or guidelines developed by some other regulatory agency?

Response: The "regulatory target levels" (page 1-5,) refer to State Water Resources Control Board California Ocean Plan water quality objectives, San Francisco Bay Regional Water Quality Control Board's San Francisco Bay Basin water quality objectives, and U.S. EPA Water Quality Criteria for water sample analysis results. Total Threshold Limit Concentration (TTLC) levels, background levels, and AET values developed for Puget Sound sediments, were considered in the EIS as regulatory target levels for sediments. The State of California does not currently have regulatory target levels for estuarine sediments.

Comment #4: The proposed test species are listed in Table 5 not Table 4 (page 2-4, line 3). The word amphipod should begin with a lower case "a" in the phrase"... and an Amphipod" (page 2-4, line 5).

Response: Table 4 (Analytical Methods for Inorganics/Metals) was considered repetitive as the same information is given in Tables 5, 6, and 7 and was therefore removed from the ESAP. The table containing the proposed test species is now Table 4. The "a" in amphipod has been changed to a lower case "a".

Comment #5: Will five replicate tanks be used both for the two reference locations and the control station (page 2-4, line 18)? That seems to be the meaning of this sentence.

Response: Yes, five replicate tanks will be used both in the bioassays for the reference location sediments and the control station sediments.

Comment #6: Sediment sieved during collection of amphipods (page 2-4, line 30) should be retained and returned to the bioassay laboratory for use in the burial phase of the amphipod bioassay (ASTM E1367, page 13).

Response: The amphipod test protocol will generally follow the Swartz method outlined in the 1991 EPA/COE Greenbook protocol rather than the ASTM method suggested.

Comment #7: Amphipods should be placed in holding containers with a minimum sediment layer of 30 millimeters (EPA/COE, page 11-12) for transfer to the bioassay laboratory.

Response: Section 2.3.2, page 2-4, states that the holding tanks in which the amphipods are placed, following collection, will contain a minimum sediment layer of 30 millimeters (mm).

Comment #8: Holding tanks for benthic organisms should contain a minimum sediment layer of 50 millimeters (EPA/COE, page 11-12).

Response: In Section 2.3.3.2, page 2-5, a sentence has been added that holding tanks for benthic organisms will contain a minimum sediment layer of 50 mm, as per EPA/COE "Greenbook" requirements.

Comment #9: The minimum dissolved oxygen level is referenced as "Section 2.6.7" (page 2-5, line 10) actually is in Section 2.6.1.6 (page 2-10).

Response: The minimum dissolved oxygen level referenced as "Section 2.6.7" has been changed to "Section 2.6.2.6".

Comment #10: The entire group of amphipods collected for a sediment test should be discarded and not used in the test if more than 5 percent of the amphipods emerge from the holding tank sediment and appear unhealthy during the 48 hours preceding the test (ASTM E1367. page 10).

Response: The amphipod test protocol will follow the Swartz method outlined in the 1991 EPA/COE Greenbook protocol instead of the ASTM method suggested.

Comment #11: What type of container is a "linear glass jar" (page 2-6, line 3) Are the screw caps for the wide-mouth glass jars made of teflon (page 2-6, line 7) or merely lined with teflon?

Response: The word "linear" has been removed and "wide-mouth" added to page 2-6 to describe the sample containers. The screw caps for the wide-mouth glass jars are lined with teflon. The text on page 2-6 has been changed to reflect this.

Comment #12: How will the ten grab samples of sediment be randomized within each test station (page 2-6, line 14)?

Response: Randomness of sample collection will be accomplished through boat movement due to wind and water currents. If natural factors are insufficient to achieve random sampling, the boat will be relocated within the sediment sampling station.

Comment #13: Press-sieving is the preferred alternative for separation of infauna from sediment samples (EPA/COE, page 11-14) during initial sediment collection. In the event press-sieving is unsuccessful, an absolute minimum of baywater should be used to screen infauna from the sample station sediments (page 2-6, line 18). It should be possible to remove the infauna by swirling the sieve in a container of bay water, as opposed to playing a running steam of water over the sieve.

Response: If the wet-sieving technique proposed in the ESAP text proves to be unsatisfactory, the alternate press-sieving technique will be used. The wet sieving technique is considered less stressful to the organisms than the press-sieving method.

Comment #14: The subsampling procedure for sediment is difficult to follow (page 2-6, line 29). How can samples for physical and chemical analyses be removed from the ten liter composite container and still leave the ten liter composite container "completely filled"?

Response: The words "completely filled" have been deleted. The remainder of the composite sample left after samples for chemical and physical analysis are removed, will be sealed and labeled for use in the sediment bioassay tests.

Comment #15: The abbreviation "QAPjP" is first used on page 2-7 without definition.

Response: The Quality Assurance Project Plan (QAPjP) has been defined in the text on page 2-8.

Comment #16: Uncontaminated natural bay water or hyper-saline brine should be used for salinity adjustment when practical. Water prepared with artificial sea salts (Section 2.5, page 2-7) must be "aged" for one week with continuous aeration prior to use in bioassays (EPA/COE, page 11-14). The artificial sea water should be filtered prior to use if a residue or precipitate is present after aging (ASTM E1367, page 5).

Response: The use of artificial seawater in bioassays was requested by EPA and other agencies to ensure the "purity" of the test waters, therefore salinity adjustments will be made, if necessary, with distilled water (to decrease salinity) or a brine prepared from distilled water and artificial sea salts (to increase salinity).

In accordance with EPA/COE 1991 "Greenbook" recommended protocol, the artificial seawater will be prepared in strict accordance with manufacturer's directions. The artificial seawater will be aged, with aeration, for one week prior to use in the bioassays. If a residue or precipitate is present after aging, the seawater will be filtered, prior to use, as per ASTM protocol.

Comment #17: "Dissolve" appears to be an incomplete misspelling of dissolved (page 2-8, line 4).

Response: "Dissolve" has been corrected to read "dissolved".

Comment #18: If it is considered essential to follow the protocols for testing dredge spoils, the following changes must be made to the "modified" solid-phase protocols in the ESAP:

a. Press-sieving is the approved method for separation of infauna from sediment samples (EPA/COE, page 11-14) prior to initiation of exposure.

b. EPA/COE guidance specifically states that the experimental procedures described in Swartz et al. (1985) should be followed for preparing the exposure chambers for amphipod bioassays (page 11-15). These procedures call for a static 10-day bioassay performed in 1 liter glass beakers. What is the basis for changing to a static-renewal bioassay in an exposure chamber "not less than 20 liter" (page 2-9, line 5)? The procedures of Swartz et al. (1985) call for the sediment to be added to the exposure chamber prior to addition of the water, the opposite of the procedure detailed in Section 2.6.1.4 of the ESAP. Sediment should be allowed to settle 24 hours before introduction of the test organisms according to EPA/COE guidance, not "at least 1 hour" as called for in the ESAP. Swartz et al. (1985) also specifies continuous lighting in amphipod bioassays to minimize emergence

from the sediment, not lighting of "simulated natural conditions" (page 2-10, line 7). The procedures outlined in Swartz et al. (1985) should be followed for the amphipod bioassays and the general EPA/COE guidance for the other test species to make them directly comparable with other sediment bioassays.

c. Ammonia concentrations should be measured in static-renewal bioassays (EPA/COE, page 11-16).

d. The one hour reburial test specified in Swarz et al. (1985) for amphipod bioassays should be added to section 2.6.1.7. (page 2-10). This test is intended to separate those test organisms which are healthy, and able to burrow into the sediment, from those which are counted alive due to a minimal response to prodding.

e. The cleaning procedure must include an organic solvent rinse or heat treatment of 8 hours at 300 degrees celsius.

f. Reference-toxicant bioassays should be routinely performed on all groups or organisms used in dredge material testing (EPA/COE, page 11-16).

Response:

a. If the wet-sieving technique proposed in the ESAP text proves to be unsatisfactory, the alternate press-sieving technique will be used. The wet-sieving technique is considered less stressful to the organisms than the press-sieving method.

b. The ESAP solid phase bioassay methods have been revised to conform with the Swartz, et al., 1985 methodology as outlined in the EPA/COE Greenbook. For amphipod bioassays, the Greenbook offers alternative methods to the static-type test including static-renewal and flow-through methods for conducting bioassays. The static-renewal methodology option has been retained as a modification to the Swartz, et. al. method to simulate estuarine tidal conditions and reduce metabolites from the test animals.

c. The measurement of ammonia concentrations in the test tanks has been added to the water parameter monitoring.

d. As discussed at the TRC meeting on January 10, 1991, sublethal effects are not being considered as part of the ESAP.

e. **EPA/COE 1991 protocol will be followed in the preparation of test containers.**

f. **Reference-toxicant bioassays will be performed for the storm water runoff toxicity bioassays. The variability of reference toxicants in sediments would influence the type of sediment used in reference toxicant bioassays. However, there will be a reference test in addition to a control test.**

Comment #19: What will be the light spectrum of the fluorescent lights (page 2-10)?

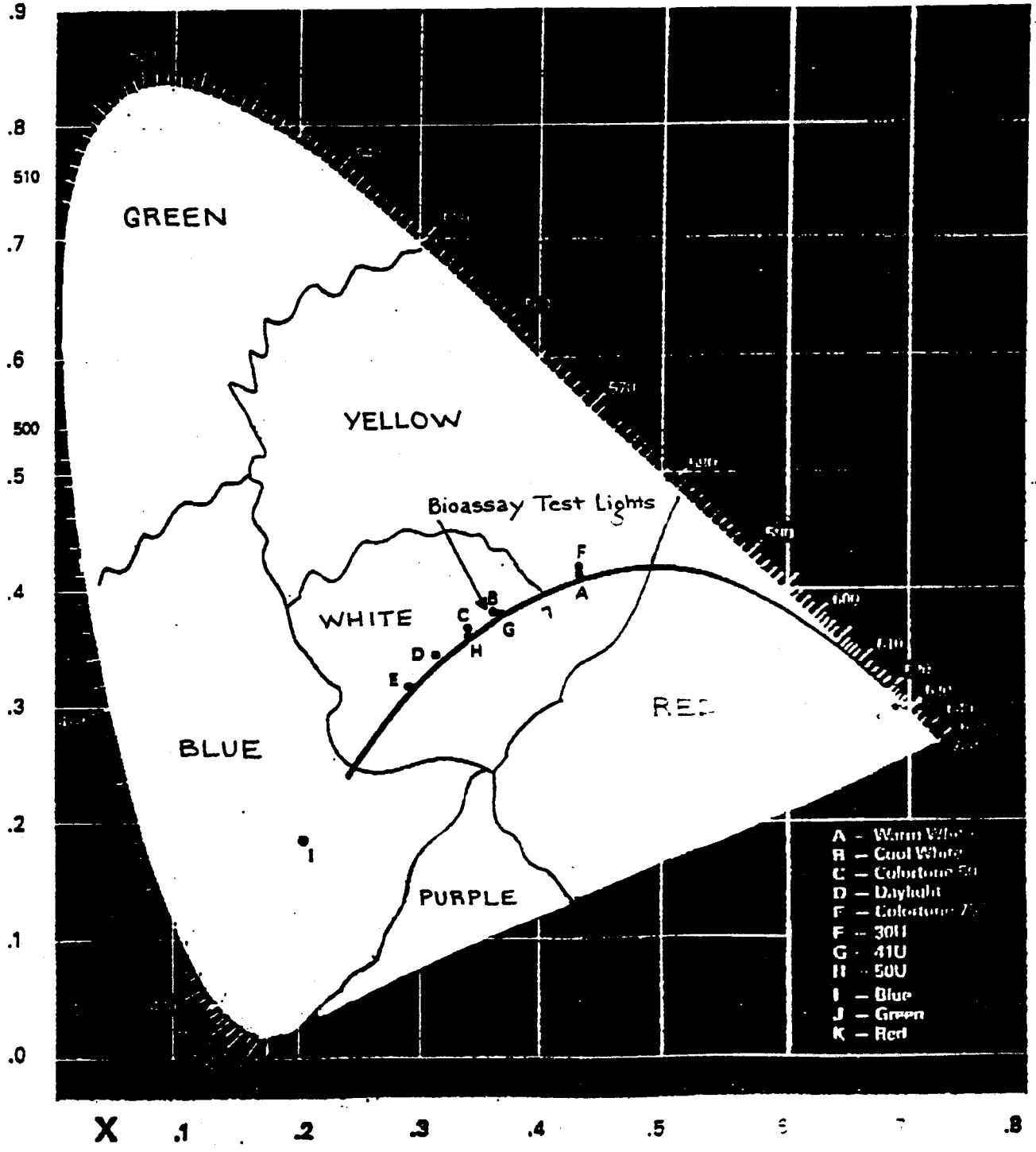
Response: **The chromaticity of a light source is usually described in terms of its color temperature or by its (X,Y) coordinates on the C.I.E. chromaticity diagram (attached). The concept of color temperature, which is based on the Kelvin temperature scale and is expressed in Kelvins (K), is used to define the color of light and is not a measurement of actual temperature. Light sources that tend to the blue end of the spectrum have a high color temperature (4000 K and above) and those that tend toward red have a low color temperature (3000 K and below). Incandescent bulbs fall in the 2,700 K portion of the scale, full-spectrum fluorescent bulbs at 5,000 K and special "blue-end" fluorescent bulbs at 7,500 K. The fluorescent bulbs utilized in the bioassay laboratory fall at 4,100 K on the scale. They emit 50 to 100 foot - candles of light.**

Comment #20: The first two sentences of the section on data presentation (page 2-10, Section 2.6.1.8) appear contradictory. If ten percent mortality in the control chamber will a priori invalidate the test results, statistical procedures should not be used to evaluate the acceptability of control mortality greater than ten percent. It seems that a statistical test is planned on those bioassays in which control mortality exceeds ten percent. Will this statistical test be a determination of the significance between the control mortality and treatment mortality or merely a statistical correction for control mortality exceeding ten percent? EPA/COE guidance specifies that the test must be repeated if the mean mortality in control tanks exceeds ten percent (page 11-16). The reasoning for any deviation from this recommendation should be clearly stated and approved prior to testing. Bioassay data presentation should include any "unusual behavioral patterns" (page 2-9) which are noted during the test. Why would the "combined survival of all three test species" be analyzed (page 2-10, Section 2.6.1.9)? The initial use of Analysis of Variance (ANOVA) seems an unnecessary step. In the event the ANOVA, or the non-parametric equivalent, indicates some treatment effect,is it not the intention to then determine which species or group of species exhibit the treatment effect? The most common type of question for

ATT

Chromaticity Diagram, Based on CIE Color Coordinates

Figure 1



multiple-species bioassays is which species demonstrated an effect due to exposure to the toxicant, not is there some effect across all species tested.

Response: **Bioassay responses at all stations will be compared to one another by using Tukey's Studentized Range (HSD) test to determine which stations differ significantly from control stations. The test will be used to determine the significance between the control mortality and treatment mortality. Unusual behavioral patterns have been added to the bioassay data presentation. The combined survival of all 3 tests species is not being analyzed; the survival of invividual species will be statistically analyzed.**

Levene's test for the homogeneity of variances will be performed first to test for the validity of the assumptions of normality and constant variance. If Levene's test shows that the data is parametric, the analysis of variance (ANOVA) and associated multiple comparison procedure known as Dunnett's Test will be performed. If Levene's test shows that the data is non-parametric (does not satisfy ANOVA assumptions of normality and constant variance), a non-parametric test (i.e. Kruskal-Wallis test) will be performed for comparison, followed by a Wilcoxin test, if necessary.

Comment #21: The adjustment of the alpha rejection level for multiple groups is the "Bonferroni" adjustment (page 2-11, line 2). The description of the statistical analysis plan is somewhat difficult to follow. What station(s) will be the statistical control, the "control" station or the "reference" station? What are the null and alternative hypotheses of each statistical test? The Bonferroni adjustment for sequential multiple group comparison may or may not be the appropriate statistical test depending on the statement of the null and alternative hypotheses. Complete data sets should be furnished so that independent evaluation of the statistical testing procedure is possible.

Response: **The statistical analysis plan has been revised as indicated in the Response to Comment #20. The control station will be the statistical control. Complete data sets will be furnished for independent evaluation of the statistical testing procedure.**

Comment #22: Reference-toxicant bioassays are not mentioned in the ESAP. Reference-toxicant bioassays should be routinely performed on all groups of organisms used in dredge material testing (EPA/COE, page 11-16).

Response: **See Response to Comment 18 (f).**

Comment #23: Sediment-water ratios are difficult to follow in the "liquid suspended particulate phase bioassay" procedure. Initially, a 1:4 sediment-water mixture is mixed and allowed to settle (page 2-11, section 2.6.2.1).

Then a 4:1 sediment-water mixture is introduced to the test tanks (page 2-12, section 2.6.2.4). The title of this bioassay indicates the liquid phase which was siphoned off (page 2-11, Section 2.6.2.1) is the test media. What ratio of water to sediment is proposed by the ESAP?

Response: **On page 2-15, Section 2.6.5.4 (previously page 2-12, Section 2.6.2.4), the sediment-water ratio has been changed to 1:4.**

The test media in this suite of bioassays is the liquid and suspended particulates siphoned off after the sediment-water mixture preparation as per EPA/COE "Greenbook" protocol for liquid suspended particulate phase bioassays described in Section 2.6.5.1. Initially, sediments are combined with prepared artificial seawater in a volumetric sediment-to-water ratio of 1:4. The sediment-seawater mixture is mixed for 30 minutes. The mixture is then allowed to settle for 1 hour. The liquid and the sediment remaining in suspension after 1 hour is siphoned off for use in the bioassay. The sediment-to-water ratio in the mixture siphoned off is dependent on how much sediment remains in suspension after one hour (which is dependent on grain size). An exact sediment-to-water ratio in this mixture would be difficult to determine and would not be relevant to the test results.

Comment #24: The t-test reference, Snedecor and Cochran, 1980, does not appear in the list of references (page 2-13, Section 2.6.2.9). The same sentence does not appear to be complete.

Response: **The reference is "Snedecor, G.W., and G.C. Cochran, Statistical Methods. Iowa State University Press, Ames, Iowa. 507 pp., 7th edition, 1980". The Snedecor and Cochran, 1980, reference has been included in the list of references.**

The sentence should read "The t-test (Snedecor and Cochran, 1980) will be used to compare the mean control and test survivals following the Levene's test for the homogeneity of sample variances". The words "is performed" have been removed from the text.

Comment #25: The list of analytical methods is Table 6, not Table 5 (page 2-13, section 2.7). Sediment detection limits (Table 6) are above sediment concentrations associated with adverse effect by NOAA for five organic and one inorganic chemicals (ER-L):

	NOAA ER-L (mg/kg)
PCB	0.05
Endrin	0.00002
p,p-DDE	0.002
p,p-DDD	0.002
p,p-DDT	0.001
Antimony	2

Detection limits should be low enough to detect those sediment concentrations, whether or not the detection limits are more stringent than CLP levels required in the Superfund program.

Response: **The reference to Table 5 is now correct as Table 4 (Analytical Methods for Metals/Inorganics) has been removed from the revised ESAP.**

Detection limits requested by NOAA (ER-L levels) can be achieved for analytes of concern except for Endrin. Achievable detection limits for Endrin by laboratories consulted varies from 2.5 ppb down to 0.5 ppb. If a laboratory that can achieve detection limits of 0.02 ppb can be identified by the regulators, we will utilize that laboratory.

Comment #26: In the original Table 6, on page 4 of 4, there is a footnote (a) which states that the quantitation limit values for inorganics are given in mg/Kg, but in the revised tables (dated 29 Mar 1991) the footnote was omitted. Please determine whether this footnote should be re-inserted into the tables.

Response: **Table 5 (formerly Table 6) in the ESAP has been revised to clarify quantiation limit values.**

Comment #27: The first paragraph under 3.4 is misleading, since the purpose is not just a qualitative determination of presence of chemicals, but also their concentrations. The State Mussel Watch (SMW) Program uses three replicates of 15 composited individuals for tissue analysis of metals to reduce the variability of the final tissue concentrations. The fact that SMW is a monitoring project and that somehow differs from the tests in the ESAP to characterize the sediment off Hunters Point Annex is not relevant. As attempts have been made to duplicate, as closely as possible, the SMW procedures, consideration should be given to the placement and chemical analysis of three replicates of 15 composited individuals for metals analysis.

Response: The mussel station locations are more closely clustered in a much smaller area than the SMW Program stations (e.g. 17 stations proposed for HPA are spaced 400 to 1200 feet between stations. The SMW Program has a total of 15 stations for the entire San Francisco Bay). The mussel deployment program will be performed twice, once in January/February and again in August/September. Due to the replicate nature of the program, it is not considered necessary to include three replicate samples per station.

Comment #28: Will the maximum depth of deployment actually be "90 meters" (page 3-5, line 9)? No depth charts are supplied with the ESAP, but the "Mussel Transplant Station" (Plate 4) indicates the stations will be fairly close to shore and probably not at 90 meters. SMW samples are deployed by divers using standard SCUBA gear. Diver placement of the buoy anchors at 90 meters would be extremely difficult.

Response: No, the actual depth of deployment will be approximately 9 meters or less. The text has been changed to reflect this.

Comment #29: What type of "artifacts" result from exposure periods greater than 30 days (page 3-5, line 13)? The SMW Program uses exposure periods from two to six months without serious interferences.

Response: "Artifacts" refers to the accumulation of chemicals in mussel tissue that may not be attributable to HPA but rather to other sources occurring during long exposure periods. The State Mussel Watch (SMW) program is designed to monitor long-term changes in water quality of California coastal marine waters and to identify areas where concentrations of toxic substances are elevated above normal background. The SMW program does not, however, monitor site-specific sources of potential contamination as is intended in the HPA ESAP mussel transplant program.

Comment #30: Comparison of differences among the tissue contaminant levels associated with the different mussel planting stations will undoubtedly occur. Whether these comparisons are statistically based or not they will include more than just the "presence of chemicals" (page 3-9, line 6). Consideration should be given to increasing the number of replicates in the mussel planting so that some statistical tests can be performed.

Response: See Response to Comment 27.

Comment #31: At what point in San Francisco Bay will the water samples be collected to "provide a basis for comparison with the storm water samples." (page 4-1, line 17)? Sampling of Hunters Point Annex storm water runoff should be conducted so that the samples are as representative as possible of

the precipitation collected in the storm drain system. No Zone of Initial Dilution (ZID) should be allowed as sometimes provided for in some NPDES discharge permits (page 4-2, line 14).

Response: Bay water sampling locations are shown on Plate 5 as stations B-1 through B-4. These sampling stations are located in the bay at the storm water outfalls so that samples are as representative as possible of the ambient conditions in the bay adjacent to the storm water outfalls during a storm event. Storm water sampling stations (ST-1 through ST-4) were established in the storm drain system (with no zone of initial dilution). Bay water samples collected near outfalls will be utilized to compare salinities and contaminant concentrations between storm drain samples and bay samples.

Comment #32: The Bioassay Procedures section (page 4-5, Section 4.7) states that "Synergistic, antagonistic, and additive effects of chemical, physical, and biological components will be considered..." in fathead minnow, freshwater alga, inland silverside and marine alga bioassays. The individual synergistic, antagonistic, or additive effects of chemical, physical or biological components are impossible to separate given the type of bioassay data that will be collected. This phrase should be removed or reworded to state the types of effects that will actually be determined.

Response: The terms "synergistic, antagonistic, and additive" have been removed from the text and replaced with the word "toxic effects".

Comment #33: The response of the organisms in both algal bioassays will be measured in terms of "cell counts, biomass, chlorophyll content, or absorbance" (Section 4.7.1.3 and 4.7.2.3). Which of these methods will be used? The use of "or" instead of "and" indicates that one method of measurement will be used. What criteria will be used to determine the preferred method?

Response: The response of the organisms in both algal bioassays will be measured in terms of cell counts (Sections 4.7.1.3 and 4.7.2.3). The words "biomass, chlorophyll content and absorbance" have been deleted from the text.

CONCLUSIONS

Determination of the type of biological community associated with the submerged and exposed portions of the inlet between Hunters Point Annex and Candlestick Park should be pursued. Definition of this area as a wetland

would enlarge the type of study needed to fully categorize the potential impact of Hunters Point Annex.

Response: See General Comment Response #1.

Population-level and community-level differences between reference stations and areas potentially impacted by Hunters Point Annex should be investigated. Most of the effort required for this determination is already planned and a minimum of additional effort would be required to address this important question.

Response: See General Comment Response #2.

The sediment bioassays should be modified so that they more closely follow established protocols. Solid-phase bioassays with amphipods should follow the guidance in Swarz, et al., 1985. EPA/COE and ASTM guidance on exposure chamber cleaning, holding mortality, control mortality, reference-toxicant bioassays, test condition monitoring, and artificial sea salt preparation should be more closely followed.

Response: See General Comment Response #3.

Detection limits for sediment analysis should be low enough to encompass the levels associated with adverse impacts by NOAA.

Response: See Specific Comment Response #25.

Once the comments detailed above are addressed, the studies outlined in this Environmental Sampling and Analysis Plan should provide a preliminary survey of the potential impacts associated with Hunters Point Annex to the soft-bottom benthic species and some near-shore species in San Francisco Bay.

RESPONSE TO RWQCB COMMENTS ON THE DRAFT FINAL ENVIRONMENTAL SAMPLING AND ANALYSIS PLAN AND QUALITY ASSURANCE PROJECT PLAN

General Comments

Comment #1: When will recent intertidal sediment sampling data be available (HLA, 90)?

Response: Intertidal sediment sampling data (HLA, 1990) will be available in the data submittals for Operable Units I and IV.

Comment #2: Will all sediment and storm drain chemistry data be presented in one report? Will sediment and storm drain chemistry be presented and discussed along with bioassay data in one report?

Response: All sediment and stormwater chemistry data for the ESAP, and bioassay data resulting from ESAP activities will be presented and discussed in one report. The results of previous storm water sampling and analysis performed by Harding Lawson Associates is presented in HLA's Draft Water Quality Investigations of Stormwater Drainage, Naval Station, Treasure Island, Hunters Point Annex, San Francisco, California, July 10, 1991.

Specific Comments

Comment #1: Qualifications (page 2-5): Not mentioned in either the ESAP or QAPP are the personnel who will carry out the bioassay work. Will the persons doing the field and lab work be employees of ATT or a contract lab? Regardless of which company facilitates this project, it is appropriate to submit the qualifications of the persons who will conduct the work, with emphasis on those persons conducting taxonomic evaluations.

Response: Aqua Terra Technology (ATT) bioassay lab will be conducting the bioassay testing. The QA/QC document for the ATT bioassay laboratory which includes personnel qualifications, facilities and equipment descriptions, and laboratory QA/QC protocols may be reviewed by the agencies. The ATT laboratory has been approved by the RWQCB and certified by DHS. Agency personnel are invited to visit the laboratory before or during the bioassay testing. Specific QA/QC protocol can be discussed with laboratory personnel.

Comment #2: Sediment Grab Samples: This draft of the ESAP proposes to augment sediment collection with core sampling for chemical analysis. While I agree that core sampling is appropriate, it may be appropriate to drop the use of "surficial grab" samples altogether and use part of the cores for the solid-phase bioassays. This would better the comparability of the resultant chemical and toxicity data and probably save the Navy some money.

In addition, it might be appropriate to conduct a gross benthic survey while onsite. While field staff are collecting sediment samples, they could also screen grab samples for infauna. The result would be a preliminary population survey which may answer the most rudimentary questions about the effects of bioaccumulation on animals near HPA, namely, are there any animals living there at all, and if so, which ones are there? Such questions will need to be addressed by the Navy at some point in time.

Response: **Sediment Grab Samples: Only one core per sediment sampling station area is proposed while 10 surficial sediment grab samples per station area will be collected. Contamination of surficial sediments in the vicinity of HPA is of primary concern because contaminants in surficial sediments have the greatest potential for toxicity to benthic species. For this reason, the emphasis in sampling (i.e. number of samples collected) was directed towards surficial sediments. The volume of sediment obtained by the grab sampler is more appropriate for the sediment sample collection for use in the bioassay as it obtains a greater volume than coring. Analysis for sediment grain size and total organic carbon has been added to the sediment core sample analytical program in the ESAP to improve comparibility between core and grab sample results.**

After chemical analytical and bioassay test results from ESAP activities have been assessed, additional testing, including benthic surveys, will be considered. The objective of the ESAP is to evaluate whether there is contamination present at the proposed sampling location regardless of what organisms live there. Should remedial activities be considered, the question of whether there are benthic populations present would be appropriate.

Comment #3: Control Sample Locations (Plate 6): How were the control sample locations determined? There are major industrial dischargers (i.e., NPDES, State Superfund) located along the Contra Costa coastline. The condition presented in the first bullet on page 2-3 would probably be invalidated by obtaining control samples from such an area.

We are concerned that the control samples obtained from locations presented in Plate 6 may turn out to be as polluted or more polluted than samples taken at HPA. Could control sediments be obtained from an area of the San Pablo

Bay which is outside the influence of the Petaluma Bay outfall (as suggested in NOAA's letter of November 11, 1990). yet also significantly distant from Contra Costa County? Perhaps an assessment of all point discharges in the Bay is necessary to pick the potentially least "impacted" site. NOAA has obtained relatively "clean" sediments from an area located roughly where Marin, Napa, Contra Costa and Alameda County lines converge. It may also be appropriate to obtain control samples from outside the Bay from a less impacted water body, for example Tomales Bay.

Related to the result of this environmental sampling, the RWQCB is undertaking a program to assess Bay sediments. The program is designed to locate and quantify sediment "background" levels and locate "Hot Spots". The program is, in part, a response to the "Toxic Hot Spots Bill", chaptered as 13390-13396 of the Porter-Cologne Water Quality Control Act (Water Code) and will involve sampling of sediments from throughout the Bay ("Regional Monitoring Program").

Because the program will eventually result in a sizable database of sediment quality data, it is important that the Navy's bioassay and chemistry data be comparable with that gathered by the RWQCB. The protocol for sediment, pore water and water column toxicity testing will generally be equivalent to the Corps of Engineers protocol, with the exception of the amphipod protocol, which is taken from the Puget Sound Protocol, NOAA, 1986 and a paper by Dewitt and Schwartz. If you have specific questions about the RMP, please contact Karen Taberski of the RWQCB at (415) 464-1346.

Response: **In accordance with EPA's request for the designation of a more appropriate control area from which "pristine or nearly-pristine sediments that duplicate the natural conditions under which the test organisms are found", control sediments will be collected from the area in which the test organisms are collected (i.e. Bodega Bay). In the case that the test organisms are purchased from a commercial supplier, the control sediment will be obtained from the supplier.**

The sediment station located in San Pablo Bay, formerly designated as a "control station" has been re-designated as a reference station. This station has, however, been relocated to the northern side of the shipping channel, away from potential land-based contamination sources, as recommended by EPA. The reference stations located south of HPA will be retained as additional "background" reference stations to approximate conditions in the vicinity of HPA exclusive of contamination contributed to San Francisco Bay by the Hunter's Point facility.

We have been informed that the RWQCB's "Regional Monitoring Program" is not scheduled to be implemented for at least six months to a year. It is not appropriate to redesign the ESAP around this program because the data from the RWQCB Regional Monitoring Program will probably not be available for at least six months to a year after the initiation of the program.

Comment #4: Page 2-7: The ESAP mentions use of "Loran-C" navigation system. How accurate and reliable is this system?

Response: Page 2-7: The Loran-C navigational system is accurate to within one-one hundredth of a minute. Reliability of the system is dependent on weather conditions and other stratospheric occurrences since it is based on electronic signals from federally installed stations.

Comment #5: Plates 3 & 5: How was sediment station S-1 positioned relative to the existing storm drains (Outfall Area "B", "C") in that area of the facility? Would it be appropriate to shift S-1 to the south to better address contaminants which were discharged from those outfalls (e.g., battery acid from the submarine battery repair building)?

Response: Plates 3 & 5: Sediment sampling station area S-1 and mussel deployment station M-1 have been moved to the south to better address potential contaminant releases from outfall B. Sediment sampling station area S-2 is already located to address potential contaminant releases from outfall C.

Comment #6: Page 3-5:

a. How do the goals of the State Mussel Watch Survey differ from those of the proposed HPA mussel study?

Response a: The State Mussel Watch (SMW) program is designed to monitor long-term water quality changes in California coastal marine waters and to identify areas where concentrations of toxic substances are elevated above normal background levels. The SMW program does not, however, monitor specific sources of potential contamination. The ESAP mussel transplant program is designed to evaluate whether contaminants (toxic or bioaccumulative substances) are being released from sites at HPA into surface waters.

b. What are the pros and cons of a 30-day deployment vs. a longer term deployment such as 45-day or 60-day?

Response b: 30-day Deployment Period - Pros and Cons:

	PROS	CONS
o	**Greater retrieval rate is probable for a shorter deployment period (decreases possibility of vandalism or detachment of mussel station).**	**Tissue analysis results may not be comparable to SMW Program because the deployment time is shorter.**
o	**Significant "artifacts" (i.e accumulation of chemicals in mussel tissue that may not be attributable to HPA) in tissue may be produced in longer deployment period.**	
o	**ASTM protocol specifies 28-day exposure period is sufficient for bioaccumulation tests.**	
	No scientific peer review exists to justify the length of time the SMW Program leaves its stations in place. It is our understanding that the deployment period utilized by the SMW Program is dependent on funding from the SWRCB.	

c. What are the "significant artifacts in the tissues" which may be produced if the mussels are deployed for a period exceeding 30 days? The RWQCB usually requires mussel deployment periods ranging from 45 to 90 days.

Response c: "Artifacts" refers to the accumulation of chemicals in mussel tissue that may not be attributable to HPA. The ASTM protocol for bioaccumulation studies specifies a 28-day exposure period.

APPENDIX B

Equipment and Glassware Cleaning Procedures for Metals and Organics Analyses

EQUIPMENT & GLASSWARE CLEANING PROCEDURE FOR METALS ANALYSES

The following procedures are recommended by the SMW Program (SWRCB, 1988) for the cleaning of equipment and glassware used for metals analyses:

- Soak equipment and glassware in the detergent MICRO® for 3 days prior to use
- Rinse thoroughly with tap water and follow with rinses of deionized water
- Soak in 6N HCl (reagent grade) for 3 days
- Rinse 6 times with Milli-Q® water (18 megaohm deionized water)
- Used glassware should be soaked for an additional 3 days in 7N HNO_3, followed by thorough rinsing with Milli-Q® water
- Soak in Milli-Q® water for 3 days and rinse with Milli-Q® water
- Oven or air dry in a covered polyethylene container previously cleaned with MICRO® and throughly rinsed with deionized and Milli-Q® water

EQUIPMENT & GLASSWARE CLEANING PROCEDURE FOR ORGANICS ANALYSES

The following procedures are recommended by the SMW Program (SWRCB, 1988) for the cleaning of equipment and glassware used for organics analyses:

- Wash equipment and glassware in hot, soapy water
- Rinse thoroughly with tap water and deionized water
- Rinse with glass-distilled methanol
- Rinse with glass-distilled petroleum ether

REFERENCE

SWRCB, State Water Resources Control Board, California State Mussel Watch 1986-1987., Water Quality Monitoring Report No. 88-3, 1988.

APPENDIX C

Preparation of Mussel Tissue Samples for Metals, Mercury, Organics, and Tributyltin Analyses

PREPARATION OF MUSSEL TISSUE SAMPLES FOR METALS ANALYSES

Sample digestion prior to analysis of antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc will be conducted using the following procedures (SWRCB, 1988):

- Place 3 to 5 gram wet weight aliquot of homogenized sample in 30 ml beaker and dry at 70° C for 72 hours (place in oven in clean polyethylene container covered with paper towels to avoid contamination)
- Weigh dried sample and add 5 ml of 70% pure HNO_3
- Reflux sample for 3 hours and take slowly to dryness
- Char sample at 350° C to decompose lipids and edissolve in 5 ml pure HNO_3
- Further oxidize sample by dropwise addition of 30% H_2O_2 and take to near dryness
- Redissolve sample in 20 ml of 1% HNO_3 in Milli- Q^R water and transfer to clean 30 ml polyethylene vial

PREPARATION OF MUSSEL TISSUE SAMPLES FOR MERCURY ANALYSIS

Sample digestion prior to analysis of mercury will be conducted using the following procedures (SWRCB, 1988):

- Place 0.5 to 1 gram wet weight aliquot of homogenized sample in 20 ml stoppered glass tube and add 3 ml of 2:1 solution of H_2SO_4 and HNO_3
- Digest in water bath for 3 hours at 50° C and cool

The following procedures to be used are an adaptation of the Stainton (1971) syringe procedure used by the SMW Program (SWRCB, 1988) for the transfer of nanogram quantities of mercury vapor for analysis by flameless atomic absorption spectrophotometry:

- Add 6 ml of 6% $KMnO_4$ gradually and allow sample to react for 12-18 hours; add an additional 1 ml of 6% $KMnO_4$ to ensure oxidation
- Clear sample with a few drops of 30% H_2O_2 and back titrate with 6% $KMnO_4$ until sample turns pink
- Aspirate 2 ml of sample, 2 ml of reductant and 6 ml of air into 10 ml syringe; cap and mix contents on vortex mixer for 10 seconds
- Inject mercury vapor into a 15 cm borosilicate glass cell fitted with silica end windows.

The reductant must be made up fresh daily and consists of 600 ml of metal-free water, 100 ml of H_2SO_4, 5 g NaCl, 10 g $(NH_2OH)\ 2H_2\ SO_4$ and 20 g of $SnSO_4$ diluted to 1000 ml with Milli-Q® water.

PREPARATION OF SAMPLES MUSSEL TISSUE FOR ORGANICS ANALYSES

Homogenized samples will be extracted for organics analyses according to the following procedures of the Food and Drug Administration (FDA, 1970) which are used by the SMW Program (SWRCB, 1988):

- Blend a 50 g wet weight sample aliquot for 2 minutes with 200 ml acetonitrile in a glass blender (with stainless steel blades) on high speed
- Filter sample with suction through a 8 cm Buchner funnel fitted with a prewashed Whatman #42 filter paper into a 500 ml separatory funnel
- Add 50 ml of petroleum ether to the funnel and shake vigorously for one to two minutes
- Add 5 ml of saturated NaCl and 300 ml of deionized water to the separatory funnel and mix vigorously in a horizontal position for 30 to 45 seconds
- Allow layers to separate and discard aqueous phase
- Gently wash the remaining solvent layer with two 50 ml portions of deionized water
- Discard washes and transfer 40 ml of the solvent layer to a glass stoppered graduated cylinder
- Add 3 gm anhydrous Na_2SO_4 to the cylinder and shake mixture vigorously

The following procedures modify the use of a Florisil column by the SMW Program (SWRCB, 1988) and allow for analysis by the alternative methods:

- Transfer the dried extract to a Kuderna-Danish (K-D) evaporative concentrator equipped with a 10 ml collection ampule
- Add a few clean boiling chips to flask and attach a three-ball Snyder column.
- Prewet Snyder column by adding 1 ml solvent (methylene chloride) to top and place K-D apparatus on steam or hot water bath so that concentrator tube and lower rounded surface of flask are bathed in hot water or vapor
- Adjust vertical position of apparatus and water temperature as required to complete concentration in 15-20 minutes
- When apparent volume of liquid reaches 1 ml, remove K-D apparatus and allow to drain at least 10 minutes while cooling
- Rinse K-D apparatus with small volume of solvent and adjust sample volume to 10 ml with the solvent to be used in instrumental analysis

PREPARATION OF MUSSEL TISSUE SAMPLES FOR TRIBUTYLTIN ANALYSIS

Homogenized samples will be extracted for tributyltin analysis according to the following procedures used by the SMW Program (SWRCB, 1988):

- Centrifuge 10 grams of tissue, 10 ml of 50% HCl, and 25 ml of methylene chloride for 15 hours to separate
- Remove methylene chloride and evaporate under a stream of air
- Dissolve residue in hexane
- Wash hexane in a 3% NaOH solution to remove all the monobutyl- and dibuty-tins, and reevaporate to dryness
- Digest residue with 1 ml concentrated nitric acid and dilute to 5 ml with deionized water
- Co-inject 10 μL of sample with 10 μL of matrix modifier consisting of 100 μg phosphate and 10 μg magnesium nitrate per analytical injection

REFERENCES

FDA, U.S. Food and Drug Administration, Pesticide Analytical Manual. Vol. I., Sec. 211.13f, Food and Feeds, Department of Health, Education and Welfare, 1970.

STAINTON, M. Syringe procedure for transfer of nanogram quantities of mercury vapor for flameless atomic absorption spectrophotometry. Anal. Chem. 43(4):625-627, 1971.

SWRCB, State Water Resources Control Board, California State Mussel Watch 1986-1987., Water Quality Monitoring Report No. 88-3, 1988.